S. HRG. 100-598

RESTART OF THE PILGRIM I NUCLEAR POWERPLANT

HEARING

BEFORE THE

COMMITTEE ON LABOR AND HUMAN RESOURCES UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

SECOND SESSION

ON

EXAMINING THE PROPOSED RESTART OF THE PLYMOUTH, MA, NUCLEAR POWERPLANT, AND THE POTENTIAL IMPLICATIONS FOR THE PUBLIC HEALTH AND SAFETY IN THE SURROUNDING COMMUNITIES

JANUARY 7, 1988—PLYMOUTH, MA

Printed for the use of the Committee on Labor and Human Resources

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RESTART OF THE PILGRIM I NUCLEAR POWER-PLANT

THURSDAY, JANUARY 7, 1988

U.S. SENATE,
COMMITTEE ON LABOR AND HUMAN RESOURCES,
Plymouth, MA.

The committee met at 7 p.m., at the Carver Regional High School, Plymouth, MA, Senator Edward M. Kennedy (chairman of the committee) presiding.

OPENING STATEMENT OF SENATOR KENNEDY

The CHAIRMAN. We'll come to order. We have a very full program this evening and this is an extremely important hearing. We're going to insist on order. We very much appreciate all the courtesies that have been provided by the townspeople here in Plymouth. We want to thank Mr. Simon, the superintendent of schools, for making the facility possible.

As I mentioned, we have a full agenda, a number of panels. We want to make sure that the views of all of our witnesses are given adequate consideration, so we're going to insist that the hearing move along. In a situation like this, we are always caught in a time-bind between giving people an opportunity to speak and reducing the amount of time that people have, but that is the nature of many of these hearings, particularly those hearings that we have out in the field.

We will ask all of the witnesses on the panels to limit their statements to three minutes. If they have additional comments, they can make those statements a part of the record.

I would expect in a hearing like this that anyone who is going to appear before this committee ought to be able to summarize their views since we are looking at expert testimony.

We will try and conclude this hearing around 9:30 or quarter of 10. If it looks like we're going later then that, we'll take a brief break part way into the hearing, in a couple of hours.

I'll make a brief opening statement, and then we'll move on to the first panel of witnesses.

We're going to insist that all of our witnesses be sworn in during the course of these hearings. We are going to insist on order and we're going to desist from any exclamations of approval or disapproval. We're going to maintain the decorum of a committee of the United States Senate.

The Committee on Labor and Human Resources is here to look into the proposed restart of the Plymouth Nuclear Power Plant,

and its potential implications for the public health and safety in the surrounding communities. This committee has had a long involvement in oversight of nuclear powerplant safety and its effects on public health. In 1979, the committee held hearings on the accident at Three Mile Island, and a year ago, we investigated the accident at Chernobyl in the Soviet Union.

Since the dawn of nuclear power, we have learned a great deal about its potential—and about its awesome possibilities for destruction. We know more today about the health effects of radiation exposure, but many unanswered questions remain. And there is one fact of which we are certain, radiation if unleashed can cause unparalleled injury and devastation. The world learned that lesson again from the tragedy at Chernobyl where 31 people lost their lives and thousands more will die of leukemia and other radiation related diseases.

We know that nuclear plant accidents not only can happen, but do happen. In fact, the Nuclear Regulatory Commission estimates that in the next 20 years, there is a substantial chance for a core meltdown in a U.S. powerplant.

In view of these serious implications, the NRC should be evaluating more effective ways to improve public safety. Regrettably, the opposite has been true. In recent years, the Commission has weakened its efforts to protect the public. And the experience of Plymouth is a case in point.

Plymouth's history is replete with cases of mismanagement, equipment failure and regulatory violations. In May 1986, NRC officials identified it as one of the least safe plants in the country. It has been involved in a number of enforcement actions, and in January 1982, it was subjected to one of the largest NRC fines in history, totaling $550,000.

Plymouth has also received excessive "minimum satisfactory" ratings by the NRC in its periodic assessment reports. The plant relies on a containment structure that many experts agree is likely to rupture in the event of high pressure buildup.

Finally, and perhaps more important, both the Commonwealth of Massachusetts and the Federal Emergency Management Agency have concluded that residents living near the plant do not have an adequate evacuation plan in the event of a radiation emergency. Yet despite these serious ongoing problems, the Commission is continuing with the process for restarting the plant.

Residents and State officials have repeatedly called on the Agency for meaningful participation in the restart decisions. Their petitions have fallen on deaf ears. The NRC has consistently rejected requests to hold a hearing. To some extent this hearing is intended to fill that gap.

Our concerns are not limited to people residing within the 10 mile emergency planning zone, but for residents of Cape Cod and in the South Shore area as a whole. Residents fear that they will not be safely evacuated in the case of a nuclear accident, and their fear is compounded because the plant's record is unsatisfactory.

Through this hearing, the committee will obtain a better understanding of how the Commission makes its restart decision and how it evaluates recommendations for the public, from the State and from FEMA. I look forward to hearing from the witnesses.

Our first panel of witnesses this evening is comprised of residents of this area, Plymouth and Duxbury, which could be most directly affected by a restart of the Pilgrim plant. They have done a tremendous amount of work on the subject, and they are the most vivid proof of the democratic process in action. So I welcome them here tonight. I would like them to come to the witness table and we'll all hear their presentations.

They will be introduced to us by State Senator William Golden, who will also be testifying before us later this evening.

STATEMENTS OF WILLIAM GOLDEN, STATE SENATOR, NORFOLK, PLYMOUTH DISTRICT; GRACE HEALY, CHAIRPERSON OF PLYMOUTH COMMITTEE ON NUCLEAR MATTERS; MARY OTT, CO-CHAIRPERSON OF CITIZENS URGING RESPONSIBLE ENERGY; NEIL JOHNSON, CHAIRPERSON OF THE DUXBURY CITIZENS COMMITTEE ON NUCLEAR MATTERS; ANN WAITKUS-ARNOLD, CHAIRPERSON OF THE DISABLED PERSONS ADVISORY GROUP ON NUCLEAR EVACUATION FOR THE STATE OFFICE ON HANDICAP AFFAIRS, AND WILLIAM ABBOTT, PRESIDENT OF THE PLYMOUTH COUNTY NUCLEAR INFORMATION COMMITTEE, INC.

Mr. GOLDEN. Good evening, Mr. Chairman. For the record, my name is State Senator William Golden from the Norfolk, Plymouth District.

It is my pleasure tonight to welcome you and to thank you for beginning tonight a process which the Nuclear Regulatory Commission of the United States has denied the people of America and the citizens of America's hometown, Plymouth, and that is the opportunity to participate in the process of determining the future of the nuclear power plant here in Plymouth.

The witnesses on this panel before you this evening, Mr. Chairman, will be Grace Healy, the chairperson of Plymouth Committee on Nuclear Matters; Mary Ott, cochairperson of Citizens Urging Responsible Energy; Neil Johnson, chairperson of the Duxbury Citizens Committee on Nuclear Matters; Ann Waitkus-Arnold, chairperson of the Disabled Persons Advisory Group on Nuclear Evacuations for the State Office on Handicap Affairs, and William Abbott, president of the Plymouth County Nuclear Information Committee, Inc.

[The prepared statement of Mr. Golden follows:]

TESTIMONY OF MASSACHUSETTS STATE SENATOR WILLIAM B. GOLDEN BEFORE THE SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES, JANUARY 6, 1988.

Mr. Chairman,

I want to thank you and the members of this committee for the opportunity to testify before you this evening. I believe that the Piglrim Nuclear Power Station should be closed for reasons of safety, reliability and economics. There is overwhelming evidence that it is one of the worst-managed nuclear plants in the country. Its containment vessel has been proven to be defective. No emergency plans exist to adequately protect the public in the event of a serious accident at the plant. Evidence also has been mounting of serious security and radiological control problems at the plant and a recent study has demonstrated that it would be less expensive to shut the plant down than to allow it start up again.

Yet, no level of government has acted decisively to shut this plant down. Under the Atomic Energy Act, states have almost no power regarding the safety of nuclear power plants. Federal authority - which is embodied in the Nuclear Regulatory Commission - has a virtual monopoly regarding the operation of nuclear plants. Unfortunately, the Nuclear Regulatory Commission has failed to distinguish between plants that are safe and those that are not. Rather than providing a fair and open forum for resolution of nuclear safety concerns, as well

as a mechanism for closing unsafe plants, the NRC has chosen to be an advocate for the nuclear industry. Despite all of the well-documented problems at Pilgrim, the NRC has chosen to keep the plant licensed.

In July of 1986 I filed a petition with the NRC requesting a formal hearing on the suspension or revocation of Pilgrim's license to operate. Both the governor and the attorney general have since filed similar show-cause petitions with the NRC requesting hearings on the Pilgrim license. The NRC's failure to consider fully and fairly these petitions has convinced us that we cannot rely on the NRC to protect the public from the dangers presented by the Pilgrim nuclear power plant.

We urgently and respectfully request that you join our efforts by using the power of this committee to demand that the NRC hold formal hearings so that Boston Edison may demonstrate why it should be allowed to operate a plant that is unsafe, unrealiable and uneconomical.

A year and a half ago, I testified at length before the Congressional Sub-Committee on Energy, Conservation and Power in Washington, D.C., on the problems at Pilgrim. Unfortunately, very little has changed since that hearing, and the problems that I discussed in that testimony have not been resolved. Accordingly, I would like to submit that testimony again to your committee. A copy of it is attached.

Testimony of Massachusetts State Senator William B. Golden before the Congressional Sub-Committee on Energy, Conservation and Power, July 16, 1986.

Mr. Chairman:

I want to thank you and the members of the committee for giving me the opportunity to appear before you today. Shortly after World War II, the federal government initiated a bold national policy to develop the peaceful use of nuclear energy. Today, many aspects of this policy have failed. These failures imperil the health, safety and welfare of millions of Americans and stand in the way of the development of a safe and secure energy future. It is critical that we appreciate what these policy failures have meant.

The nuclear industry has not achieved uniform standards of excellence. Some plants have state-of-the-art technology. Some are well-managed. Some are appropriately located in areas away from population centers. Some are efficient, cost-effective producers of electricity. A few--those run by the military--have adequate security.

However, many others were poorly designed and now have outdated equipment. They are located in areas that are densely populated or are vulnerable because of their geography. Some plants are poorly managed. Some no longer make economic sense. Nearly all civilian reactors have inadequate protection from new and more sophisticated security threats.

The federal government, which has the central responsibility

for nuclear safety, has failed to understand local conditions and concerns. It has not made sufficient distinction between good and bad nuclear plants.

Boston Edison's Pilgrim Nuclear Power Station--located in America's home town, Plymouth, Massachusetts--has come to symbolize the failure of this policy. The problems of this plant fall in five broad categories: management, technology, emergency planning, security and economics.

Pilgrim has long suffered from poor management. In 1982, the Nuclear Regulatory Commission levied what was then the largest civil penalty in the agency's history against Boston Edison for management and safety problems. The NRC's SALP reports, or overall performance reviews, for 1981, 1982 and 1985 gave Boston Edison the lowest possible rating for plant operations. The most recent SALP report, issued this February, cited the company for poor staffing, supervision, procedures and self-assessment. A special NRC inspection report issued on April 2, again pointed out staffing and organizational deficiencies. In May, the NRC commissioners told this committee that Pilgrim is one of the worst-run and least-safe plants in the country. In June, the Massachusetts Department of Public Utilities issued a sweeping criticism of Boston Edison's overall management, concluding that the company had all but abdicated its responsibility for planning.

These reports and disclosures have destroyed public confidence in Boston Edison's ability to manage Pilgrim safely. They are sufficient cause for the NRC to hold public hearings on

whether this utility should be allowed to continue to run the plant. The NRC has refused to take this step, and because of this refusal, the public is rapidly losing confidence in the NRC's ability to regulate Pilgrim.

I urge this committee to use its influence to persuade the NRC to hold hearings on the possible suspension, revocation or transfer of Boston Edison's license to operate Pilgrim.

The adequacy of Pilgrim's containment structure is another matter of serious concern. Pilgrim is a 1960s model General Electric boiling water reactor with a Mark I containment vessel. The NRC's chief safety official, Harold Denton, recently stated that there is a 90 percent probability of failure of a Mark I vessel in the event of a core meltdown. This level of risk is intolerable. The NRC should demand that Pilgrim's containment be upgraded to the highest standards the industry can provide.

The NRC can no longer persist in ignoring important design distinctions among nuclear plants. It is time to determine whether it is more economical to upgrade the Mark I system or to close plants with Mark I containment permanently.

No issue so plainly illustrates the failure of national nuclear policy as emergency preparedness. The public might be more inclined to accept the pronouncements of the experts on the highly technical issues surrounding nuclear power if the emergency plans for nuclear plants were not so patently inadequate.

The 10-mile emergency preparedness zone, which the NRC requires of all nuclear facilities, may make sense for a plant

located in the middle of a western desert. But it is clearly inappropriate for densely populated urban and suburban areas of the Northeast.

A serious accident at Pilgrim would have effects far beyond the 10-mile zone. Plans should be developed to deal with an emergency at Pilgrim that would affect Boston, which is 40 miles away, or Cape Cod, which is only 12 miles from the plant.

Boston Edison, the NRC, and the Federal Emergency Management Agency have assigned a low priority to emergency planning. The Pilgrim plan has never received formal approval from FEMA or the NRC. FEMA did not even receive a copy of the most recent Pilgrim plan until ten months after it was prepared.

Neither the utility nor the federal government has dealt with the cost of adequate emergency planning. In an actual emergency, the crucial links in the chain of command are unpaid, minimally trained local civil defense directors. For any plan to work, professional civil defense departments with adequate staffs and equipment must be in place.

In this age of global terrorism, political extremism and individual fanaticism, it is imperative that security be upgraded at Pilgrim and all other nuclear plants. Official NRC regulations call for strict security at nuclear plants. However, this official policy has not been effectively implemented by the nuclear industry or the NRC.

In an attempt to lull the public into a comfortable feeling about nuclear power, the Atomic Industrial Forum--a nuclear industry organization--suggested last week that nuclear power

plants are ideal summer tourist attractions. This attitude is irresponsible and dangerous. Security interests require that the public be kept as far away as possible from nuclear plants.

The NRC has failed to realize that the effectiveness of its elaborate security regulations is no better than the individuals who carry them out. At Pilgrim this task falls to individuals who are recruited through classified ads in the local weekly newspaper stating, "We are looking for those individuals with a career as a nuclear security officer in mind and would like to earn $11,000 to $18,000...You must be at least 19 years old and must bring with you copies of birth certificate, drivers license, high school diploma or G.E.D. certificate." Security at nuclear plants demands higher standards.

At Pilgrim, security problems are compounded by reports of alcohol and drug abuse, horseplay in sensitive parts of the plant and continuing labor-management strife.

This committee should seriously consider having the United States military or the Department of Defense police provide direct security for Pilgrim and all other nuclear plants. Nuclear facilities are not tourist attractions. They are sensitive installations which in the wrong hands could expose civilian populations to catastrophic dangers.

Finally, national nuclear policy has failed because the federal government has lost sight of the policy's prime objective--cheap energy. A chairman of the Atomic Energy Commission once stated that nuclear power would give us electricity "too cheap to meter." This clearly has proven false.

Today, we need to re-examine all of the old assumptions surrounding the economics of nuclear power.

A cost-benefit analysis of Pilgrim has not been conducted since the plant went on line 15 years ago. Pilgrim and other existing plants are becoming increasingly expensive to run, as the costs of maintenance and safety improvements escalate. The public is demanding better security, management and safety at nuclear plants. These measures will cost money. The economics of all nuclear plants should be subjected to thorough reviews.

These reviews also should take into account items that are undervalued on company balance sheets or may not show up at all. The public has subsidized nuclear power by limiting utility liability for accidents through the Price Anderson Act. Civil defense planning and government regulation are other costs to the public of nuclear power. The future costs of decommissioning and waste disposal are still unknown.

I urge this committee to press for the suspension of Pilgrim's license until the following actions are taken:

1) The NRC holds public hearings on whether Boston Edison is qualified to manage the plant.

2) The reconstruction or replacement of the existing containment vessel so that Pilgrim has a state-of-the-art containment system.

3) The creation of a 40-mile emergency planning zone and the development of a new civil defense program, which would be funded by Boston Edison and would be capable of responding to a serious accident at Pilgrim.

4) <u>The formation of a military or Defense Department police security force for Pilgrim and all other nuclear facilities</u>.

5) <u>The completion of an economic cost/benefit analysis of Pilgrim</u>.

Three Mile Island and Chernobyl have changed forever the way Americans think about nuclear power. The test of our national nuclear energy policy no longer lies in a comfortable consensus between the utility industry and the NRC. To survive, nuclear power must prove itself not just in the nation's capital but in Plymouth, Massachusetts, and other home towns throughout America. It is time for the federal government to stop listening only to experts and technocrats and to start listening to the American people. No policy will succeed until public confidence is restored in the technology and in the ability of governemnt to manage it in the public interest.

The CHAIRMAN. Well, thank you very much, Senator Golden. We will ask all of you if you would be kind enough to stand.

[Witnesses sworn.]

The CHAIRMAN. We'll start with Mr. Abbott.

Mr. ABBOTT. Mr. Chairman, thank you for the opportunity to testify before your committee. You have asked here tonight what will be the impact upon the health and safety of the communities surrounding the Pilgrim I plant should it be allowed to start up in the next few months.

Others here tonight will address the issue of protection against a catastrophic accident and emergency planning. I would like to focus my brief comments and recommendations on the subject of radiation emissions for Pilgrim I and their control and their monitoring, or as is usually the case, the lack thereof by the NRC.

Over a year ago, I testified before two Massachusetts legislative committees advocating the funding of an effective monitoring system by the State of Massachusetts to do what the NRC does not perform. Legislation was introduced, but it died a few days ago in the final hours of the 1987 legislative session; thus we must still rely on the NRC to police the operations of Pilgrim I; a reliance, which based on past experience, certainly gives me and the residents of this area little comfort.

Pilgrim I has had a history of continued unplanned radiation releases, which are among the highest in the nation. Again and again, we see reports of radiation releases in the files; we must diligently dig through unpublicized NRC reports to see that there is this recurrent public health menace.

Now, Senator, given the reports of substantially higher than average incidents of cancer in Plymouth and towns downwind of the plant, the do-nothing approach by the State of Massachusetts and by the NRC can no longer be tolerated. To date, our efforts have been singularly unsuccessful in getting the NRC to do anything about this. They have failed miserably over the years, both in discharging their public protection function, and equally as important, in giving the public any comforting perception that it is fulfilling this function.

Operating from a distance, whether it be King of Prussia, PA, or Washington, the NRC's typical involvement is to become activated after receiving a report from Edison; dispatch a team to the site; listen to Edison's explanation, and then generally endorse and ratify Edison's report with the usual conclusion, without any further investigation, that the public health was not, in fact, impacted by the incident.

Massachusetts, likewise, has effectively failed to monitor the plant. We, through a Federal court suit years ago, got the Department of Public Health to install dosimeters in Plymouth and surrounding towns to monitor the release of radiation.

Unfortunately, the carrying out of this function has been proven nearly worthless since the devices are only read quarterly; results are hidden from public view, and even worse, Mr. Chairman, no attempt is made to correlate the reading of these devices with known accidents at the plant which could lead to off-site releases, despite Edison's predictable, self-serving statements that all releases are contained within the site perimeter.

Let me illustrate this fundamental failure with one example to show you that the responsible authorities are not protecting the citizens of the South Shore. We researched this ourselves.

In June 1982, Edison sent a detailed report to the NRC regional office explaining that highly radioactive resin beads and particulate matter, which had accumulated over an extended period of time, were found to have been accidently injected into the ventilation system and from there to the outside of the building. This material was discovered on the roofs of several of the buildings and on the grounds of the Pilgrim I plant site.

The Region I NRC office dispatched a team to the site and found that this material had been probably released through the vent duct which exhausts to the atmosphere at an elevation of about 100 feet. Ten cubic feet of this highly radioactive resin was found in the standby gas treatment system inlet plenum. This is the source of releases of radioactive materials to the atmosphere.

Now, despite the very serious potential of this accident for off-site contamination and the carrying away of radioactive dust by the winds, no effort was made to read the off-site TLDS—there are three separate sets of these maintained by the NRC, Boston Edison and the State of Massachusetts—no efforts were made to correlate those readings with this observed accident. Nobody bothered to read them to see if Edison's statement made at the time—that no radiation escaped off-site—was, in fact, true.

Now, this failure was probably due to the fact that the readings did not become available—they are only read quarterly—until several weeks after the particular release.

We did check the readings, and the results were highly significant. For instance, in the summer of 1982, all TLD locations as measured by Edison, the NRC and the State showed a large rise and then declined by the same percentage, indicating a consistent pattern. Likewise, the dose-rate decreased with distance away from the plant as one would expect from a point source. The zone closest to the plant showing the largest dose-rate.

The CHAIRMAN. What do those kinds of increases mean in practical terms, in terms of the health hazard for the population?

Mr. ABBOTT. Senator, they are substantially in excess of background radiation, and I think that anytime you add to the background radiation more radiation from the Pilgrim nuclear plant, you are adding to the health hazard of the people of the area.

We have asked the State of Massachusetts to hold hearings to set new levels of radiation standards, emission standards. This is one of the problems we have with the NRC, that the standards that they have are not consistent with current scientific evidence. But the key here is that although the statement was made that nothing escaped, clearly radiation did escape. Out as far as 20 miles toward the northwest, all locations showed an increase of radiation. The existing background dose-rates were nearly tripled in the third quarter of 1982.

About a year ago, I discussed this at a meeting with NRC at a public forum. They told me that they had not read the—the gentleman that was there was on the NRC team that inspected the plant after that accident—had not read the TLD data. He said some four years after the incident he thought the TLD data was "worth

checking." The State Department of Public Health did not do much better.

The CHAIRMAN. I'll give you another minute.

Mr. ABBOTT. The remedy to this failure is starkly obvious. Either the NRC or the State or both should gear up with the necessary manpower and equipment to monitor the day-to-day operations at Pilgrim I, including all planned and unplanned releases of radiation on a regular, continuous basis, not this haphazard hit-or-miss system that we have now. Monitoring equipment should be read on a real-time, continuous basis up to at least 20 miles from the plant, and the results made public so we don't have to search for them. Until that is in place, Senator, I say the plant should not be allowed to re-open.

The people of the South Shore deserve to know what they are being exposed to. It is of fundamental importance to our mental well-being and physical health that this system be in place. We ask the support of your committee to insure that the NRC not give its approval to Pilgrim restart, unless and until an effective real-time, continuous radiation monitoring system has been fully implemented. Thank you.

[The prepared statement of Mr. Abbott follows:]

Statement of William S. Abbott
President, Plymouth County Nuclear Information Committee,
before Senate Committee on Labor and Human Resources,
on January 7, 1988

Thank you for the opportunity to testify before your Committee. You have asked here today what would be the impact upon the health and safety of the surrounding communities from the operation of Pilgrim I should it be allowed to start up by the NRC in the next few months. Others here today have addressed or will address the issues of protection against a catastrophic accident and emergency planning. I would like to focus my comments and recommendations on the subject of radiation emissions from Pilgrim I and their control and their monitoring (or as is more usually the case, the lack thereof) by the NRC. Over a year ago I testified before two separate Massachusetts legislative committees advocating the instituting and funding of an effective monitoring system by the State of Massachusetts to be sure the citizenry is protected from the operations of Pilgrim I. Legislation was introduced, but this week it died in the final hours of the 1987 legislative session. Thus, until such legislation is once again introduced and enacted, we must rely on the NRC to police the operations of Pilgrim I - a reliance which based upon past experience certainly gives me, and I presume many others, little comfort.

Pilgrim I has had a history of continued unplanned radiation releases which are among the highest in the nation. Again and again we see reports (such as the 1986 SALP report) of unplanned radiation releases; only with diligent digging in the morass of NRC unpublicized reports do we see the true extent of

this recurrent public health menace. Now, given the reports of substantially higher than average incidences of cancer in Plymouth and towns downwind of the plant, the do-nothing approach by the State of Massachusetts and by the NRC can no longer be tolerated.

This history of Pilgrim I for the past 15 years has been one of citizen groups digging through the voluminous microfilm and technical reports, most usually in the Public Document Room in the Plymouth Public Library, to find the obscure reports of the releases of radiation by Pilgrim I into the Plymouth environs -- and then trying to get the NRC and the State Department of Public Health to do something about it. To date our efforts have been singularly unsuccessful. The NRC has failed miserably over the years -- both in discharging its public protection function, at least as regards Pilgrim I, and in giving the public any comforting perception that it is fulfilling this function. Operating from a distance, whether it be King of Prussia, Pennsylvania or Washington, D.C., the NRC's typical involvement is to become activated after receiving a report from Boston Edison, then to dispatch a team to the site, listen to Edison's explanation, and then generally endorse and ratify Edison's report -- with the usual conclusion, without any further investigation, that the public health was not adversely impacted by the incident.

The State of Massachusetts likewise has failed over the years to effectively monitor the plant's operations. And it is not for lack of trying on our part that the State is not performing this function. Several years ago as a result of federal court litigation involving Pilgrim I brought by Plymouth County Nuclear Infromation Committee, the State Department of Public

Health installed several thermoluminescent dosimeters ("TLD'S") in Plymouth and surrounding towns, supposedly to monitor the release of gamma radiation from Pilgrim I. Unfortunately, the carrying out of this function has proven to be nearly worthless since the devices are only read on a quarterly basis and the results are virtually hidden from public view -- and even worse, no attempt is made to correlate the readings of these devices with known abnormal occurrences at the plant which could lead to offsite releases despite Edison's predictable self-serving statements that all radiation releases are contained within the site perimeter.

Let me illustrate this fundamental failure of the responsible authorities to protect the citizens of the South Shore by a case in point which I researched myself. In June 1982, Edison sent a detailed report to the NRC Region I office explaining that highly radioactive resin beads and particulate matter, that had accumulated over an extended period of time, was found to have been accidently injected into the duct-work of the ventilation system, and from there to the outside of the building. This radioactive material was discovered on the roofs of several of the Pilgrim I buildings and on the ground. The NRC Region I office dispatched a team to the site which found that the resin had been probably released through the reactor building vent-duct which exhausts to the atmosphere at an elevation of approximately 100 feet. Ten cubic feet of this highly radioactive resin was found in the Standby Gas Treatment System inlet plenum (the source of releases to the atmosphere). Despite the very serious nature

of this accident and the potential for offsite contamination and the carrying away of radioactive dust by the winds, no effort was made to read the offsite TLD's (separate sets of TLD's are maintained by the NRC and Boston Edison, in addition to the TLD's maintained by the State), and correlate such readings with the observed accident at the plant. Neither the NRC nor the State ever bothered to read their TLD's to see if Edison's typically pollyannish statement that no radiation escapted offsite was in fact true. This failure was no doubt partly due to the fact that the TLD readings do not become available, given the current practice of reading them quarterly, until several weeks after any particular release. I did check the readings and the results are highly significant. For instance, in the summer of 1982, all TLD locations, as measured by Edison, the NRC, and the State, showed a large rise and then declined by about the same percentage, indicating a consistent pattern. Likewise, the dose-rate decreased with distance away from the plant, as one would expect from a point-source, the zone closest to the plant (0-0.16 miles) showing the largest dose-rate, thereby confirming that the accidental escape of highly radioactive wastes reported to the NRC did in fact lead to offsite contamination. At all locations as far away as 21 miles to the northwest, the existing background radiation dose-rates were nearly tripled in the third quarter of 1982. Despite the potential health effects of this release of radiation, a member of the NRC inspection team who had visited the plant after this release told me in the summer of 1986 that his team had not read the TLD data, and that then, some four years after the incident, he thought that these readings might be "worth

checking". And as for the State Department of Public Health, suffice it to say that it took me many long hours of digging and prodding to even get the State data out of the offices of the State employee who collected it -- just as with the NRC no attempt whatsoever had been made by the Department of Public Health to correlate this data with the accident.

This incident and the lack of follow-up by the responsible monitoring authorities illustrates the failure of the system as it exists today to protect adequately the public health of the citizenry from the operation of Pilgrim I in what has become the fastest growing area of our State. The remedy for this failure is starkly obvious: Either the NRC or the State, or both should gear up, with the necessary manpower and equipment, to monitor the day-to-day operations of Pilgrim I, including all planned and unplanned releases of radiation off-site, on a regular continuous basis -- a complete system of radiation detection devices should be installed off-site at various distances from the Plant, and read constantly and continuously -- and the results made public. Such a system, if properly designed and implemented, could add measurably to the public's confidence that its safety and health were being duly considered and protected.

And there is even more that the State can do -- the State of Massachusetts has the legal power to set its own level of maximum permissible airborne radioactive emissions from Pilgrim I. Under Section 122 of the Clean Air Act Amendments of 1977, Congress specifically provided that the States have the legal authority to set emission standards at levels which are more

stringent than standards imposed by the NRC or the EPA. And the NRC itself has recognized that the setting of such standards by a State might even prevent the construction of nuclear plants or halt the operation of existing facilities.

Meanwhile, the NRC continues to rely upon standards of permissible radiation releases which are obsolete and understate by many times the actual health risks posed by such emissions of radiation. Obviously these permissible radiation standards should be updated by the NRC, but having seen the way the NRC operates for the past 15 years, I have little hope that the NRC will do so. In the absence of NRC action it is imperative that the State of Massachusetts act in this critical area, to design and set standards of radiation releases which must be met by nuclear plants operating within the State -- standards that will take into account the latest of scientific evidence on the health effects of low-level radiation, and then to engineer and implement a monitoring system to ensure that Pilgrim I does not exceed such standards, and if it does, to shut it down. It is of fundamental importance to the mental wellbeing and physical health of the citizens of the South Shore that such a system be in place before the plant is allowed to restart. We ask the support of your Committee to ensure that the NRC not give its approval to Pilgrim restart unless and until an effective realtime continuous monitoring system, run either by the NRC or the State of Massachusetts (not Boston Edison), has been fully implemented.

The CHAIRMAN. I'm going to come back to some questions for Mr. Abbott. I would like to try and go down the panel first, and then come back with some questions. I'll ask that Ann Waitkus-Arnold testify next, and then we'll proceed to the others, she is the Chairwoman of the Plymouth Commission on the Handicapped.

Ms. WAITKUS-ARNOLD. Thank you, Senator.

The CHAIRMAN. Put that mike a little closer.

Ms. WAITKUS-ARNOLD. Thank you for the opportunity to testify before your committee. My name is Ann Waitkus-Arnold and I represent the Massachusetts Office on Handicap Affairs, and chairwoman for the Disabled Persons for the Disabled Advisory Group on Nuclear Evacuations.

I'm also the chairperson for the Public Commission on Handicap Affairs, Resource Coordinator for We the People and——

The CHAIRMAN. Slow down just a little, Ann, so we can all——

Ms. WAITKUS-ARNOLD. OK. I'm also a member of the Massachusetts Advisory Council on Handicap Affairs.

The purpose of the advisory group is to make recommendations to be used by the Massachusetts Civil Defense Agency and the utilities. This is a crucial first step in a statewide effort to insure that all people are included in planning, not only for Pilgrim I, but for Massachusetts residents affected by Yankee Atomic and for Yankee Rowe nuclear power plants.

In my official capacity for the State, I have had the opportunity to talk with representatives from Civil Defense, Department of Public Safety, Boston Edison, Yankee Atomic, and I've addressed FEMA and the NRC on several occasions. However, I have seen little evidence of any real efforts to insure the health and safety of the special needs of populations by these agencies. They may give the appearance of concern, but I have found this to be mostly lip-service. Government assurances to protect the public in the event of an accident at Pilgrim I have been deceptive and grossly irresponsible.

The NRC has licensed nuclear facilities that have not included people with disabilities and pain. And only recently has FEMA concluded that plans for Pilgrim I plant are not adequate for people with special needs.

The State's newest revised draft of October 1987, developed with the assistance of Boston Edison, now states that potassium iodine will be stockpiled for use for those who will be left behind, instead of including all citizens in actual evacuations——

The CHAIRMAN. Would you like to expand on that point?

Ms. WAITKUS-ARNOLD. OK.

The CHAIRMAN. On the significance of storing that particular chemical.

Ms. WAITKUS-ARNOLD. They will be storing that chemical—the chemical protects the thyroid gland against radioactive iodine. The problem that we have with this is that it is only to be given out to people in nursing homes, hospitals and——

The CHAIRMAN. Let's get a little more complete picture. You are talking about there being included in an evacuation plan the suggestion that some people might leave, but might leave those who have physical disabilities behind?

Ms. WAITKUS-ARNOLD. Right.

The CHAIRMAN. People in nursing homes or who have other physical disabilities. They are going to be inoculated with this, or they take a pill. They take a pill, and they take whatever radiation there is. The other people have effectively left, and they leave the handicapped or physically disabled—or physically challenged, as my son would say—behind, to take their pills and hope for the best?

Ms. WAITKUS-ARNOLD. Right. This is a drug that can cause severe allergic reactions, hemorrhaging, and even death.

Mr. CHAIRMAN. Do you have any instant reaction to that type of an evacuation plan? I can't let that quite slide by so quickly.

Ms. WAITKUS-ARNOLD. My instant reaction is anger, discrimination, and I think it is a very inhuman way to treat people, especially elders and disabled. Those are the only people targeted out for this particular type of treatment.

The CHAIRMAN. The elderly and the disabled?

Ms. WAITKUS-ARNOLD. Elderly and disabled. That means that we have a discriminatory system in our country today.

In my opinion and the opinion of the advisory group, Edison has spent a great deal of time lulling people into a false sense of security, and has consistently been misleading and deceptive on the issues of special needs.

One example is a special needs survey done by Edison at the insistence of our disability group. The purpose of the survey was to identify people who will need assistance during evacuation; unfortunately, they ignored our suggestions and offers of assistance. The resulting survey was designed in such a way as to exclude most of the people with disabilities.

Consequently, there is a stunning discrepancy between the 1986 Disability Census figure, which shows 4,000 people in Plymouth alone with severe limitations and the utilities' figures showing only 474. Edison then incorporated these erroneous figures into their new evacuation time estimates of special needs population.

The CHAIRMAN. As I understand, partially because many of those who have physical disabilities don't report them; is that right?

Ms. WAITKUS-ARNOLD. No. It's because the survey was kind of a bogus survey. It wasn't sent out to people—it wasn't sent out to any handicapped or elderly house. They refused to send it out to every household in the town of Plymouth. It wasn't understandable by many disabled people; elders who had no idea that the service pertained to them because it spoke about severe disabilities, and it did not include a lot of questions about many disabilities. Obviously, if one is blind, one would not be able to fill out the survey.

In addition, we have advocated for 2 years that Edison comply with NRC's regulations to notify and alert all segment of the community in case of an accident of Pilgrim I. This includes people who are deaf and hard of hearing.

I have testified before the NRC several times on this issue; however, proper action has not been taken to obtain and distribute special equipment to the 420 residents who have requested it from Boston Edison. I feel that the NRC is complicit in its violations of federal law because they have been aware of this violation, but have taken no action to make Boston Edison comply.

With few exceptions, there appears to be an attitude from the Federal Government on down that some elderly and disabled people are not worth consideration because exclusion is permitted. The quality of our Government is reflected by the way the Government deals with its citizens that are in need of assistance, and until this attitude changes, disabled people will be continued to be treated as second-class citizens. I'm talking about people who we love and care about, our children, parents, grandparents who may have hearing, vision or physical disabilities, the thousands of elderly who will need assistance in an evacuation; our disabled veterans in homes and hospitals and the many retarded persons in group homes, who may not even recognize that an emergency exists. What will happen to them during an emergency?

We are not asking for special treatment, only equal treatment. Failure to include elderly and disabled in planning is deprivation under the equal treatment under the 4th and 14th amendments. We are not saying we ought to come first. We just want the same chance to escape as everyone else has. Basic civil rights are the birthright of all Americans and second class citizenship should no longer be allowed. Realistic and humane emergency plans must be developed for all people and every town and village from Cape Cod to the borders of New Hampshire affected by this plant. Unless a workable plan can be designed for everybody, and until such a plan can be tested and implemented, Pilgrim I should remain closed.

There have been serious incidents which reveal the GE containment systems, like the Pilgrim I containment, had an unsafe design, making it very unlikely to withstand a major accident. This report was kept secret by GE and the NRC for 12 years. In addition, the report stated that radioactive and chemical waste in Plymouth by Boston Edison was duly reported to State and Federal authorities and has yet to be investigated after 7 years. We feel that waiting 7 years is 7 years too long to find out whether our soil and water have been contaminated.

In light of the above examples, there must be an immediate moratorium on the operation of all nuclear plants which affect Massachusetts residents, and Congress must hold a full investigation into why the NRC has failed to protect the health and safety of elderly and disabled people as well as the rest of the general public. Thank you very much for inviting me to speak.

The CHAIRMAN. We'll come back to you. Do you know of your own knowledge whether other evacuation plans treat the handicapped like this?

Ms. WAITKUS-ARNOLD. Jerome Plant.

The CHAIRMAN. Where they have similar kinds of——

Ms. WAITKUS-ARNOLD. Exactly.

[The prepared statement of Ms. Waitkus-Arnold follows:]

The Disabled Persons' Advisory Group
on
Nuclear Evacuation

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Mr Chairman:

My name is Ann Waitkus-Arnold, and I represent the Massachusetts Office on Handicapped Affairs as the Chairwoman of the Disabled Persons' Advisory Group on Nuclear Evacuation. I am also the Chairperson of the Plymouth Commission on Handicapped Affairs, Special Needs Co-ordinator for We the People,Inc. of the United States, and a member of the Plymouth Nuclear Affairs Committee and the Massachusetts Advisory Council on Handicapped Affairs. The purpose of the Advisory Group is to make recommendations to be utilized by the Massachusetts Civil Defense Agency and the Utilities. This is a crucial first step in a statewide effort to insure that <u>all</u> people are included in planning, not only for Pilgrim I, but for Massachusetts residents affected by Yankee Atomic in Rowe, and the Vermont Yankee Nuclear Power Plant. In my official capacity for the State, I have had the opportunity to work with representatives from M.C.D.A., the Departmentof Public Safety,the Boston Edison Company, Yankee Atomic, and I have addressed the Federal Emergency Management Agency and the Nuclear Regulatory Commission on several occassions.

However, I have seen little evidence of any real efforts to insure the health and safety of the Special Needs Populations by these agencies. They may give the appearance of concern, but I have found this to be mostly lip service. Government assurances to protect the public in the

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event of an accident at Pilgrim I have been deceptive and grossly irresponsible. The NRC has licensed Nuclear facilities that have not included people with disabilities in Planning, and, only recently has FEMA concluded that plans for the Pilgrim I Plant are not adequate for people with Special Needs although I realize the NRC is not obliged to take advice from FEMA. The Statés newest revised Plan, of October, 1987, developed with the assistance of Boston Edison, now states that Potassium Iodide will be stockpiled for use by those who will be left behind, instead of including all citizens in actual Evacuations. Who are these people who will be left behind? - People in Hospitals, Nursing Homes and Detention Centers, including the Plymouth County Farm. This proposed use of a drug which can cause severe allergic reactions, hemmorrhaging, and even death, is inhumane and totally unacceptable.

In my opinion, and in the opinion of the Advisory Group, BECo has spent a great deal of time and money lulling people into a false sense of security, and has been consistently misleading and deceptive on these issues. One example is the Special Needs Survey, done by BECo, at the insistance of the Disabiltiy Group. This group included people with disabilities, representatives from Independent Living Centers, and State Agencies. The purpose of that Survey was to identify people who will need assistance during Evacuation. Unfortunately, they refused our input and participation in developing a workable document, and, instead, the Survey was not done in good faith, and did not collect the needed information. Consequently, there was a stunning discrepancy between the 1986 Disability Census Figures showing 4,000 people with severe limitations in Plymouth alone, and the Utilities' figures showing only 474. BECo then incorporated their erroneous figures into their new Evacuation Time Estimates for Special Needs Populations, thereby calling into question the validity of this document.

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In addition, we have been advocating for two years that BECo comply with NRC Regulation to "notify and Alert all segments of the community" in case of an accident at Pilgrim I. This includes people who are deaf and hard-of-hearing. I have testified before the NRC several times on this issue, however, proper action has not been taken to obtain and distribute special equipment to the 421 residents who have requested it from BECo. I feel the NRC is complicit in this violation of Federal Law because they have been made aware of this violation, but have taken no action to make BECo comply.

With few exceptions, there appears to be an attitude from the Federal Government on down that elderly and disabled people are not worth consideration, because exclusion is permitted. This is defacto discrimination. The quality of our Government is reflected by the way the Government deals with it's citizens who are in need of assistance, and, until this discriminatory attitude changes, disabled people will continue to be treated as second class citizens. I'm talking about people whom we love and care about - our children, parents and grandparents who may have hearing, vision, or physical disabilities, the thousands of elderly who will need special assistance, our disabled veterans in homes and hospitals, and the many retarded persons in Group Homes, who may not even recognize that an emergency exists. What will happen to them during an Emergency? These people are human beings who are important to our communities. We are not asking for special treatment, only equal treatment. Failure to include elders and disabled citizens in Evacuation Planning is depravation of Equal Treatment under the Fifth and Fourteenth Amendments. We're not saying we want to be first - we just want the same chance to escape as everyone else, however small that may be. Basic Civil Rights are the birthright of all Americans, and second class citizenship must not be allowed. Realistic and humane

(4)

Emergency Plans must be developed for all people in every town and village from Cape Cod to the borders of New Hampshire! Unless a workable plan can be designed for everyone, and until such a plan can be tested and implemented, Pilgrim I must remain closed.

There have been serious incidents, including the Reed Report, which revealed that GE containments, like the Pilgrim I vessel, have an unsafe design making it very unlikely to withstand a major accident. This report was kept secret by GE and the NRC for 12 years! In addition, the reported dumping of radioactive and chemical waste in Plymouth by BECo, duly reported to State and Federal Authorities, has yet to be investigated after seven years. We feel that waiting seven years is seven years too long to find out whether our soil and ground water have been contaminated.

In light of the above examples, there must be an immediate Moratorium on the operation of all Nuclear Plants which affect Mass. residents, and Congress must hold a Full Investigation into why the NRC has failed to protect the health and safety of Elderly and Disabled people, as well as the rest of the general public.

Thank you, Mr. Chairman, for inviting me to speak on these issues, and I would be happy to answer any questions you might have.

Ann Waitkus-Arnold

Ann Waitkus-Arnold

Chairwoman

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DECEMBER 4, 1987

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PRESS RELEASE

ANN WAITKUS-ARNOLD APPOINTED CHAIRWOMAN OF DISABLED PERSONS ADVISORY GROUP ON NUCLEAR EVACUATION

ANN WAITKUS-ARNOLD OF PLYMOUTH WAS RECENTLY APPOINTED BY THE MASSACHUSETTS OFFICE OF HANDICAPPED AFFAIRS TO BE CHAIRWOMAN OF THE DISABLED PERSONS ADVISORY GROUP ON NUCLEAR EVALUATION. THE PURPOSE OF THE ADVISORY COMMITTEE IS TO MAKE RECOMMENDATIONS TO THE STATE-WIDE TASK FORCE ON CIVIL DEFENSE TO INSURE INCLUSION IN EVACUATION PLANNING FOR PEOPLE WHO ARE ELDERLY AND/OR DISABLED IN ALL AREAS OF THE STATE NEAR NUCLEAR POWER STATIONS.

THE ADVISORY GROUP CONSISTS OF ADVOCATES WHO ARE DISABLED FROM THROUGHOUT THE STATE. IT HAS MET WITH BOSTON EDISON, YANKEE ATOMIC, AND THE MASSACHUSETTS CIVIL DEFENSE AGENCY. IT IS EXPECTED TO RECOMMEND THE HIRING OF A PROFESSIONAL CONSULTANT TO RESEARCH THE DEMOGRAPHICS OF PEOPLE WITH DISABILITIES NEAR NUCLEAR POWER PLANTS; TO DETERMINE THEIR NEEDS IN THE EVENT OF AN EMERGENCY; TO DETERMINE WHICH PEOPLE IF ANY, CANNOT BE EVACUATED; AND TO DETERMINE THE ATTENDENT RISKS IN REMAINING WHERE THEY ARE.

"THIS ADVISORY GROUP IS A CRITICAL FIRST STEP IN THE STATEWIDE EFFORT TO DEAL WITH EMERGENCY EVACUATION PROCEDURES FOR ALL PEOPLE," ACCORDING TO JIM GLEICH, DIRECTOR OF THE MASSACHUSETTS OFFICE OF HANDICAPPED AFFAIRS.

The CHAIRMAN. Mr. Johnson.

Mr. JOHNSON. Thank you, Senator for this opportunity to testify before the committee.

My name is Neil Johnson. I'm the chairman of the Duxbury Citizens Committee on Nuclear Matters, and a member of the Duxbury Emergency Response Committee also. I am a registered professional engineer and have design experience working on nuclear power plants as a licensing, environmental and structural engineer.

I would like to address three areas: switchyard and emergency diesel generators, overpressurization failure and direct torus venting and stress corrosion cracking.

First, the switchyard and emergency diesel generators. On November 12, 1987, at approximately 2:10 a.m., the Pilgrim nuclear power station experienced a complete loss of offsite power, LOOP, during adverse Weather conditions. This resulted in a start-up of two emergency diesel generators. Prior to the restoration of offsite power at 11:15 p.m. on the same day, one of the diesel generators had to be shut down, leaving only one diesel generator operating. The event was not given a licensee emergency classification by the NRC, as the plant was in cold shutdown.

It was reported that the loss of offsite power was associated with icing in the switchyard. I'm concerned that similar problems with the plant operating could occur in the future that could result in more serious consequences.

Since June of 1972, there have been 20 instances of loss of the 345 kv offsite system and four instances of loss of both the 345 kv and the 23 kv offsite system. This would be considered four LOOP events, L-O-O-P.

I believe that prior to restart, the NRC should review the switchyard and emergency diesel generators as a system and assure the public that the integrity of this system can be maintained under adverse conditions.

Based on the recent diesel generators and switchyard problems, I believe that the NRC should require completion of the installation of the new 2,000 kw blackout diesel prior to the restart.

The conclusion of the NRC Augmented Inspection Team review of the November 12 incident, the loss of the offsite power was that the inoperability of the B emergency diesel generator resulted from the performance of maintenance using inadequate or incomplete maintenance procedures.

I believe that the NRC should assure the public that BECO will more aggressively pursue courses of action to mitigate mechanical problems such as those experienced on the B emergency diesel generator.

The next topic is on overpressurization failure and direct torus venting.

The CHAIRMAN. Let me just briefly ask you what would have been the effect if you had a diesel generator fail, if the plant had been on-line?

Mr. JOHNSON. Had the last diesel generator failed and the plant been on-line, it would have been a station blackout. There is—there are some emergency batteries that would keep things going for a short time. But without offsite power and without the two diesel generators, you have a station blackout.

The CHAIRMAN. What does that mean, station blackout?

Mr. JOHNSON. That means you don't have power to run the service water system and your systems required for safe shutdown.

The CHAIRMAN. So the systems for safety would have been effectively shut down; is that what you are saying?

Mr. JOHNSON. Yes. There are some batteries that would keep things going for a period of time. OK, overpressurization failure and direct torus venting. I understand that severe accidents in the extreme can generate pressures of more than twice the design pressure of a Mark I containment structure similar to the one at Pilgrim and could cause containment rupture. One core damage prevention strategy utilized is containment venting of excess pressure gradually. I have a sketch attached for those who would like to see. This is achieved by bubbling the release from the gas treatment system—excuse me, from the reactor dry well through the wet well on through the standby gas treatment system, the SBGT, where remaining radioactive iodine and particulates are removed, finally venting out through the main plant stack. Incidently, the standby gas treatment system remained out of service from 1984 through at least 1986 at Pilgrim.

It is also my understanding that the existing vent duct work associated with the standby gas treatment system is of fairly light gauge and may be broached in accident venting. Therefore, the installation of the direct torus vent system, which provides a direct vent path, with heavier gauge pipe around the standby gas treatment system was proposed at Pilgrim. Installation of this system was begun, but not completed due to a lack of approval by the NRC.

I believe that the NRC should be concerned about the effects of secondary release of radioactive gas into the reactor building in the event of duct work failure. Also, if in the future, the NRC approves the direct torus venting system, I believe that they should review the operation of the manual override, which would allow the operator to manually override switches to allow venting to continue even with high radiation in the torus vapor space. I know that's fairly technical, but——

The CHAIRMAN. That is very technical. [Laughter.]

I'll give you 30 seconds to translate it for everyone. Let's just take a minute and give us the essence of it, if you would.

Mr. JOHNSON. OK. With a station blackout, there are spray systems that would cool the reactor. However, if those fail due to no power or some other problem, then there is direct torus venting or a venting out of the dry well portion of the containment through the wet well.

The CHAIRMAN. As I understand it, they don't have torus venting; they want to have torus venting?

Mr. JOHNSON. Yes. They have started installation of torus venting which would bypass the standby gas treatment system. That has not been given approval by the NRC.

The CHAIRMAN. Edison desired to design a standby system, but NRC has not approved that?

Mr. JOHNSON. They felt it was conflicting—I forget the exact terminology. Conflicting safety issues, I think is the terminology.

The CHAIRMAN. Some translate that as possibly the fact that if Boston Edison is prepared to put it in, that might suggest that others should put it in their plants, and others might not be willing to do it. I don't know if that's fair.

Mr. JOHNSON. I'm also a bit concerned in that there is a manual override in the event of high pressure and high radiation that would allow an operator to open a valve to bypass the SBGT and to go right out to the atmosphere via the main plant stack.

[The prepared statement of Mr. Johnson follows:]

STATEMENT OF NEIL JOHNSON

Good evening. My name is Neil Johnson, and I,m the Chairman of the Duxbury Citizens Committee on Nuclear Matters and a member of the Duxbury Emergency Response Committee. I am a registered Professional Engineer and have 13 years of design experience working on nuclear power plants as a Licensing, Environmental and Structural Engineer. I,d like to address 3 areas - Switchyard and Emergency Diesel Generators, Overpressurization Failure and Direct Torus Venting and Stress Corrosion Cracking.

Switchyard and Emergency Diesel Generators

On November 12,1987 at approximately 2:10 AM, the Pilgrim Nuclear Power Station experienced a complete loss of offsite power (LOOP) during adverse weather conditions. This resulted in startup of the two emergency diesel generators. Prior to the restoration of offsite power at 11:15 P.M. on the same day, one of the diesel generators had to be shut down leaving only one diesel generator operating. The event was not given a licensee Emergency Classification by the NRC as the plant was in cold shutdown.

It was reported that the loss of offsite power was associated with icing in the switchyard. I am concerned that similar problems with the plant operating could occur in the future that could result in more serious consequences.

Since June of 1972 there have been 20 instances of loss of the 345 kV offsite system and 4 instances of loss of both the 345 kV and the 23 kV offsite systems (4 LOOP events).

I believe, that prior to restart, the NRC should review the switchyard and emergency diesel generators as a system and assure the public that the integrity of this system can be maintained under adverse conditions.

Based on the recent diesel generator and switchyard problems I believe that the NRC should require completion of the installation of the new 2000 KW blackout diesel prior to the restart.

The conclusion of the Augmented Inspection Team review of the November 12, 1987 loss of offsite power was that the inoperability of the "B" emergency diesel generator resulted from the performance of maintenance using inadequate or incomplete maintenance procedures.

I believe that the NRC should assure the public that BECO will more aggressively pursue courses of action to mitigate mechanical problems such as those experienced on the "B" emergency diesel generator?

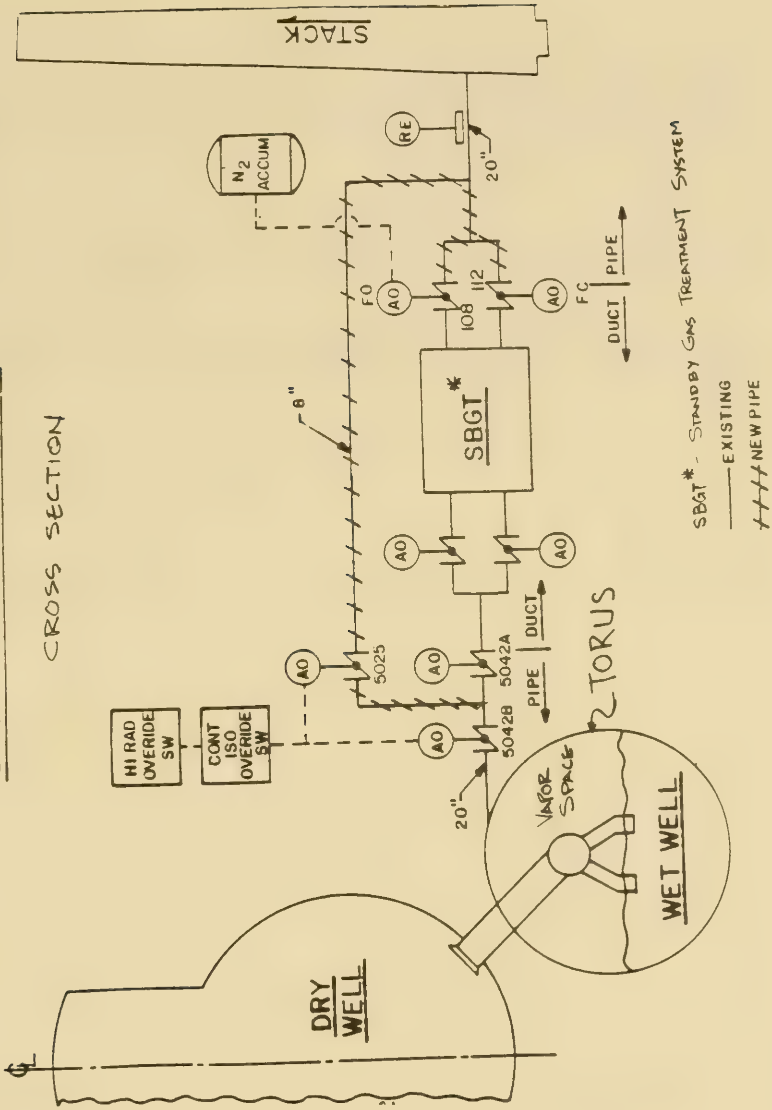
Overpressure Failure and Direct Torus Venting

I understand that severe accidents in the extreme can generate pressures of more than twice the design pressure of a Mark I containment structure similar to the one at Pilgrim and could cause containment rupture. One core damage prevention strategy utilized is containment venting of excess pressure gradually. (see attached sketch). This is achieved by bubbling the release from the reactor drywell, through the wet well, on through the Standby Gas Treatment System (SBGT) where remaining radioactive iodine and particulates are removed, finally venting out through the main plant stack. Incidentally, the Standby Gas Treatment System remained out of service from 1984 through at least 1986 at Pilgrim.

It is also my understanding that the existing vent ductwork associated with the Standby Gas Treatment System is of fairly light gague and may be broached in accident venting. Therefore the installation of a Direct Torus Vent System which provides a direct vent path, with heavier gauge pipe, around the Standby Gas Treatment System was proposed at Pilgrim. Installation of this system was begun but not completed due to a lack of approval by the NRC.

I believe that the NRC should be concerned about the effects of secondary release of radioactive gas into the reactor building in the event of a ductwork failure. Also, if in the future the NRC approves the Direct Torus Venting System, I believe that they should review the operation of the manual overide which would allow the operator to manually overide switches to allow venting to continue even with high radiation in the Torus vapor space.

PROPOSED
DIRECT TORUS VENT SYSTEM
CROSS SECTION



Stress Corrosion Cracking

The 1987 update of the summary of findings and recommondations in the Reed Report - 1975 - General Electric Corporation states that stress corrosion cracking (SCC) is a complex, industry-wide problem affecting both BWR's and PWR's, and relates fundamentally to the harsh environment in which components and piping must operate in nuclear power plants.

In December of 1983, the NRC ordered the lisensee to shut down and inspect the recirculating system piping for integranular stress corrosion cracking. The licensee replaced the recirculating system piping and was authorized to restart in December 1984.

I recommend that the NRC make sure that all recommendations by General Electric to upgrade BWR reliability as impacted by stress corrosion cracking have been implemented at Pilgrim so that this condition does not reoccur in the future.

Questions

In the restart plan reference is made to the fact that 4 shifts of operators will be available during startup and power ascension and that 6 shifts will be available in the longer term. Since 4 shifts are not able to cover the work week of 21 shifts without regular use of overtime (50 % overtime), how soon will Edison have 6 shifts available?

Would the NRC please obtain and make available to the public the records of hours worked by the operators on duty on November 12, 1987. A two week period prior to and including November 12, 1987 would be appropriate.

The restart plan states that "It is not intended as a go/no go acceptance criteria. They may proceed if their performance falls reasonably within a goal?" Who determines if their performance falls within a goal and what criteria is used?

We would like the NRC to discuss decommissioning costs and methods. How can we be assured that decommissioning will be adequately funded for Pilgrim I when it has outlived its usefulness? What lessons has the NRC learned from the Shippingport Pa. decommissioning?

What will the NRC do to insure that groundwater ingress both through the seams in the Process Building wall and through the conduit penetration for the switchyard sump pump is corrected?

The CHAIRMAN. OK. We'll go to Mary Ott. We're trying to open up the back here so that we can have some of our other guests go up on the stage. It might be somewhat uncomfortable, but at least they'll be able to observe.

I'm informed that there is another room here where they are covering this through a TV monitor, I'm informed the back is loaded with equipment. I don't know where the fire marshall is, but we'll check. Anyway, we'll move on.

Mary Ott, we'll hear from you.

Ms. OTT. Good evening, Senator Kennedy. We commend you for calling this important meeting and are very grateful for the opportunity to express our deepening concern about the health and safety impact with the restart of Pilgrim, and further at the failure of the Nuclear Regulatory Commission to perform its sanctioned duty to regulate this utility.

Our concerns encompass Pilgrims flawed GE Mark I containment, its poor management history, the lack of evacuation plans for area residents, the threat posed by the continued stockpiling of tons of nuclear waste on site, the alarming increase in cancer in the five towns downwind, and finally, the credibility of the Boston Edison Co. and its regulator, the NRC.

Although a conclusive link has not been found, Pilgrim's history has heightened suspicion of the connection between the plant and increased cancer incidents in surrounding communities. The State Department of Public Health confirmed this increase in 1986.

Because the report was criticized for omitting crucial data, a new study was promised, which was to include more recent data, causal factors, occupational risks and study of cancer incidence in communities near nuclear powerplants in New England. This study should be completed before Pilgrim is allowed to restart.

Pilgrim's poor management has been a serious concern since the plant was licensed in 1972. Edison's decision to use known defective fuel resulted in widespread contamination of the plant and contributed to their inability to control iodine releases during the early 1970's. They subsequently applied to the NRC for a revision of specifications to provide for, quote, "operational flexibility", end quote. It was granted.

Following Edison study findings in 1982, the NRC assigned special priorities to monitoring the management of Pilgrim. By 1986, 16,000 hours of inspection time had been spent at Pilgrim, and a third resident inspector assigned. This is 50 percent more inspection hours than spent in similar plants in the northeast, a peculiar commitment of resources to oversee a plant that the NRC keeps assuring us has always been operated in a safe manner.

Following Edison—oh, excuse me. Still the problems persist. Since 1984, about 100 mishaps have occurred at Pilgrim; 12 accidents have occurred since 1982, causing Edison to notify state officials and police. Despite the objections of State Secretary of Public Safety, 22 legislators and concerned residents, Edison refueled the reactor with no evacuation plan in place and without notifying the appropriate authorities.

They also commenced the refueling on the very day they assured the press that the procedure would be done a week later. When questioned about the contradiction, the NRC responded, quote, "if

the utility lied to the public or to reporters, there is no authority under the Atomic Energy Act for the NRC to do anything about it. There is no law that says they have to tell reporters the truth," end quote.

In November of 1987, a series of spills and leaks resulted in the contamination of several workers. Edison's vice president was in Florida at the time. There was no NRC resident inspector on site. Plant spokesmen originally denied any leaks, and then later acknowledged them. Later a single generator was the only source of electricity to provide cooling for the loaded reactor. If the plant had been operating and that generator failed, we would have had to implement the evacuation plan that we do not have.

Something is wrong here, Senator. Boston Edison has withheld documents from the public document room with the permission of the NRC. Many missing have been obtained through the Freedom of Information Act and chronicle a history of unmonitored releases to our environment. Edison continues to tell us that there has been no releases in excess of technical specifications. The NRC has not made any attempt to contradict the known misinformation.

During the last 18 months, we have been assured by the NRC and the industry that nuclear power has defense in depth, and we're often reminded that there are inherent risks associated with all forms of energy. The risks we are being asked to bear are unacceptable.

Since local and State officials are powerless to resolve our dilemma and the NRC refuses to hear our requests for a legal hearing, we appeal to your committee to initiate an independent, congressionally sponsored investigation into the health and safety impact of the operation of Pilgrim, and further into the conduct of the Nuclear Regulatory Commission. Only a legal inquiry can provide the truth about Pilgrim's troubled history. Such a hearing is needed if public confidence in our system and in the NRC is to be restored. Thank you, Senator.

[The prepared statement of Ms. Ott (with attachments), follows:]

TESTIMONY OF MARY C. OTT, CO-CHAIRMAN, DUXBURY CITIZENS URGING RESPONSIBLE ENERGY (CURE) BEFORE THE U.S. SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES, JANUARY 7, 1988.

Senator Kennedy, members of the Senate committee, my name is Mary Ott and I am the Co-Chairman of Duxbury Citizens Urging Responsible Energy. We commend you for calling this important meeting, and are grateful for the opportunity to express our deepening concern about the health and safety impact of the restart of the Pilgrim Nuclear Power Station and further, at the failure of the U.S. Nuclear Regulatory Commission (NRC) to perform its sanctioned duty to regulate this utility.

Our concerns encompass Pilgrim's flawed GE Mark I containment; its poor management history; the lack of evacuation plans for area residents; the threat posed by the continued stockpiling of tons of nuclear waste on site; the alarming increase of cancer in the five towns downwind; and finally the credibility of the Boston Edison Company and its regulator, the NRC.

Although a conclusive link has not been found, Pilgrim's history has heightened suspicion of the connection between the plant and increased cancer incidence in surrounding communities.

The State Department of Public Health confirmed this increase in 1986. Because the report was criticized for omitting crucial data, a new study was promised which is to include more recent data, causal factors, occupational risks, and a study of cancer incidence in communities near nuclear power plants in New England. This study should be completed before Pilgrim is allowed to restart.

Pilgrim's poor management has been a serious concern since the plant was licensed in 1972. Edison's decision to use known defective fuel resulted in widespread contamination of the plant, and contributed to their inability to control Iodine releases during the early '70's. They subsequently applied to the NRC for a revision of technical specifications* to provide for "operational flexibility." It was granted.

Following Edison's precedent-setting $550,000 fine in 1982, the NRC assigned special priority to monitoring the management of Pilgrim. By 1986, 16,000 hours of inspection time had been spent at Pilgrim and a third resident inspector assigned. This is 50% more inspection hours than spent at similar plants in the Northeast. A peculiar commitment of resources to oversee a plant that the NRC keeps assuring us has always operated in a safe manner.

Still, the problems persist. Since 1984, about 100 mishaps have occurred at Pilgrim.* Twelve accidents have occurred since 1982, causing Edison to notify state officials and police.

Despite the objections of the State Secretary of Public Safety, 22 legislators and concerned residents, Edison refueled the reactor with no evacuation plan in place and without notifying appropriate authorities. They also commenced the refueling on the very day that they assured the press that the procedure would be done a week later. When questioned about the contradiction, the NRC responded, "If the utility lies to the public or to reporters, there is no authority under the Atomic Energy Act for the NRC to do anything about it. There is no law that says they have to tell reporters the truth."*

In November a series of spills and leaks resulted in the contamination of several workers. Edison's Vice President was in Florida at the time. There was no NRC resident inspector on site. Plant spokesmen originally denied any leaks, then later acknowledged them.

*BECO letter to NRC dated May 22, 1975

*South Look, Karl Abraham, Region I, NRC, Oct. 6-8, 1987

The plant experienced a complete lost of offsite power for 21 hours. A single generator was the only source of electricity to provide cooling to the loaded reactor. If the plant had been operating, and that generator failed, we would have had to implement the evacuation plan that we do not have.

Something is wrong here. Boston Edison has withheld documents from the public document room with the permission of the NRC. Many missing have been obtained through the Freedom of Information Act and chronicle a history of unmonitored releases to our environment. Edison continues to tell us that there have been no releases in excess of technical specifications. The NRC has not made any attempt to contradict the known misinformation.

During the last 18 months, we have been assured by the NRC and the industry that nuclear power has "defense in depth," and are often reminded that there are inherent risks associated with all forms of energy. The risk we are being asked to bear is unacceptable.

Since local and state officials are powerless to resolve our dilemma, and the NRC refuses to grant our request for a legal hearing, we appeal to your committee to initiate an independent, Congressionally-sponsored investigation into the health and safety impact of the operation of Pilgrim; and further, into the conduct of the Nuclear Regulatory Commission.

Only a legal inquiry can provide the truth about Pilgrim's troubled history. Such a hearing is needed if public confidence in our system, and the NRC, is to be restored.

Thank you.

Postscript: CURE Co-Chairman, Dr. Donald M. Muirhead Jr. and his associate Dr. Belton Burrows have submitted additional written testimony regarding the health effects of radiation.

DOCKET-50-293 -- 4.35 V

BOSTON EDISON COMPANY
Executive Offices
800 Boylston Street
Boston, Massachusetts 02199

20.98

May 22, 1975

Director
Division of Reactor Lic[illegible]
Office of Nuclear Rea[illegible] Regulation
U.S. Nuclear Regulat[illegible] Commissio[illegible]
Washington, D.C. 20555

Do[illegible]et No. 50-293
License DPR-35

Subject: Proposed Revision to Airborne Effluents
Technical Specification for Pilgrim Unit #1

Dear Sir:

Operation of Pilgrim Nuclear Power Station in accordance with the present Technical Specifications has revealed that section 3.8.B.2 of the specifications should be revised to more accurately describe the intent of the specification and provide operational flexibility. Accordingly, B[illegible]ton Edison Company hereby requests that the attached proposed revisio[illegible] to Technical Specification pages 179, 179A, 179B, 191A and 191B be [illegible]sued to provide the necessary clarification and definition.

This submittal has been approved by the Onsite Review Committee but has not been reviewed by the Nuclear Safety Review and Audit Committee (NSRAC). NSRAC review is underway and will be completed during the week beginning May 27, 1975.

This proposed Technical Specification must be considered temporary since it does not reflect the requirements contained in the new Appendix I to 10 CFR 50 issued by the Commission on April 30, 1975 (and published in the Federal Register, Volume 40, No. 87, May 5, 1975). Boston Edison will propose further revisions to the Technical Specifications on effluent releases in accordance with the new Appendix I not later than June 4, 1976.

Very truly yours,

MASTER

Commonwealth of Massachusetts)
County of Suffolk)

Then personally appeared before me Francis M. Staszesky, who, being duly sworn, did state that he is Executive Vice President of Boston Edison Company, the applicant herein, and that he is duly authorized to execute and file the proposed Technical Specification revisions described herein in the name and on behalf of Boston Edison Company and that the statements in said proposed revisions are true to the best of his knowledge and belief.

My Commission expires:

Notary Public

DALE G. S[illegible]

TABLE 2

LER SYNOPSIS (11/01/85 - 01/31/87)

PILGRIM NUCLEAR POWER STATION

LER NUMBER	EVENT DATE	CAUSE CODE	SUMMARY DESCRIPTION
85-028-00	10/10/85	X	INADEQUATE SURVEILLANCE PROCEDURE FOR STANDBY GAS TREATMENT SYSTEM
85-029-00	10/18/85	X	HIGH PRESSURE COOLANT INJECTION SYSTEM AND ANTICIPATED TRANSIENT WITHOUT SCRAM SYSTEM INVERTERS INOPERABLE
85-030-00	10/30/85	X	INADEQUATE RECIRCULATION PUMP START PROCEDURE
85-031-00	10/29/85	X	FAILURE TO MEET MINIMUM SHIFT CREW COMPOSITION
85-032-00	11/25/85	B	MAIN STEAM LINE HIGH FLOW SWITCH SETPOINT DRIFT
85-033-00	11/27/85	X	MAIN STACK AND RBV MISSED SURVEILLANCE TEST
85-034-00	12/31/85	B	TECHNICAL SPECIFICATION REQUIRED FIRE DAMPERS FOUND DEGRADED
86-001-00	01/06/86	A	UNPLANNED REACTOR SCRAM ON LOW WATER LEVEL DUE TO OPERATOR ERROR
86-002-00	01/16/86	X	REACTOR SCRAM DUE TO PRESSURE SWITCH SENSITIVITY
86-003-00	02/11/86	E	480 V SAFETY BUS INADVERTENTLY DEENERGIZED DURING MAINTENANCE
86-004-00	02/20/86	X	STANDBY LIQUID CONTROL SYSTEM DECLARED INOPERABLE WHEN SQUIB VALVES NOT TESTED INSITU
86-005-00	03/07/86	B	HEAD SPRAY PIPING LEAK IN TORUS ROOM
86-006-00	03/16/86	B	WELD LEAK ON REACTOR WATER LEVEL INSTRUMENT LINE

LER NUMBER	EVENT DATE	CAUSE CODE	SUMMARY DESCRIPTION
86-007-00	03/22/86	X	MAIN STEAM LINE ISOLATION WHILE REACTOR SHUTDOWN
86-008-00	04/04/86	X	REACTOR SCRAM AND MAIN STEAM ISOLATION VALVE (MSIV) RESET PROBLEMS
86-009-00	04/11/86	X	IN SERIES PRIMARY CONTAINMENT ISOLATION VALVES MO-1001-28B AND 29B INDICATING LEAKAGE PAST SEATS
86-010-00	04/15/86	X	MAIN STEAM LINE ISOLATION WHILE REACTOR SHUTDOWN
86-011-00	04/19/86	X	LEAKAGE PAST MSIV'S IN EXCESS OF LLRT CRITERIA
86-012-00	05/16/86	X	INSUFFICIENT ONCE/CYCLE HPCI SURVEILLANCE PROCEDURE
86-013-00	05/30/86	B	USE OF NON-SEISMIC GENERAL ELECTRIC TYPE CFD RELAYS
86-014-00	06/10/86	X	INSUFFICIENT ONCE/CYCLE RCIC SURVEILLANCE PROCEDURE
86-015-00	06/13/86	X	PRIMARY CONTAINMENT LOCAL LEAK RATE TESTS OVERDUE
86-016-00	06/21/86	E	BUS A5, BUS A6 AND STARTUP TRANSFORMER DEGRADED VOLTAGE RELAY CALIBRATIONS OVERDUE
86-017-00	07/01/86	X	CONTAINMENT ISOLATION VALVE LOCAL LEAK RATE TEST FAILURES
86-018-00	06/29/86	X	GENERAL ELECTRIC AKF FIELD BREAKER FAILED TO TRIP AUTOMATICALLY
86-019-00	07/15/86	X	INSUFFICIENT MONTHLY ATWS SURVEILLANCE PROCEDURE
86-020-00	08/20/86	D	UNIDENTIFIED FIRE BARRIER WALLS AND PENETRATIONS

LER NUMBER	EVENT DATE	CAUSE CODE	SUMMARY DESCRIPTION
86-021-00	08/27/86	B	STANDBY GAS TREATMENT SYSTEM DELUGE SYSTEM SINGLE FAILURE MODE
86-022-00	08/29/86	E	MISSED TECHNICAL SPECIFICATION SOURCE LEAK CHECK SURVEILLANCE
86-023-00	09/12/86	A	MISSED FIRE WATCH AND FIRE WATCH PATROLS
86-024-00	10/07/86	X	NON FIRE RESISTANT COATED STRUCTURAL STEEL
86-025-00	11/11/86	B	MISALIGNMENT OF THE FIRE SUPPRESSION WATER SYSTEM
86-026-00	10/29/86	D	FAILURE TO PERFORM RADIO-ACTIVE MATERIAL SURVEILLANCE TEST OF STANDBY GAS TREATMENT SYSTEM AND LIQUID RAD. EFFLUENT MONITOR
86-027-00	11/19/86	C	LOSS OF OFFSITE POWER DUE TO SEVERE WINTER STORM
86-028-00	12/23/86	X	FAILURE TO RECOGNIZE THE EFFECTS OF ELECTRICAL ISOLATION RESULTING IN ESF ACTUATION
86-029-00	12/23/86	X	LOSS OF OFFSITE POWER WHILE WASHING SALT FROM YARD INSULATORS

NOTE:

There is no published synopsis of Licensee Event Reports for 1987 at this time. Per the Librarian, Grace Karbot, in the Plymouth Public Document Room, 19 such events did occur in 1987.

1984	20
1985	34
1986	29
1987	19
TOTAL	102

Refueling activates criticism

By Thelma O'Brien
South Look staff

Boston Edison began in earnest loading uranium into the Pilgrim nuclear reactor Tuesday, Sept. 29, after a false start on Sept. 27 and an information contradiction that inflicted another public relations wound on the utility.

The delicate operation was meant to start Sunday and was stopped, according to Edison spokesman John Fidler, because some safety equipment was found to be inadequate. The delay, Mr. Fidler and others said, would last about a week. Then the loading began again at 5:13 Tuesday, catching the press and others off-guard. Several legislators and plant watchers reacted angrily to the mixup, suggesting that if either deception or incompetence was responsible, neither one was reasonable.

Carl Abraham, a Nuclear Regulatory Commission spokesman, said the commission had no reason to disbelieve Edison about the equipment problem. He said the company had permission from NRC to refuel and that he couldn't say why Pilgrim said the delay would take a week.

"If the utility lies to the public or to reporters," Mr. Abraham said, "there is no authority under the Atomic Energy Act for the NRC to do anything about it. There is no law that says they have to tell reporters the truth."

Hardly anything can stir the technological imagination as effectively as a visit to a nuclear powered plant during reactor refueling.

Even though Pilgrim has not operated since April 1986, when the NRC shut the plant for safety and management breaches, the building remains a repository for radioactive materials.

Here men do their jobs as engineers, fire watchers, sweepers, inspectors, cleaners, health workers and other things, dressed in protective clothing that covers everything but the face, and sometimes that is covered as well.

Pilgrim workers peer into the fuel pool during uranium reloading at Pilgrim.

(Thelma O'Brien photo)

As workers move from contaminated places to those areas marked clean, they shed their irradiated gear for clean clothes, placing the contaminated jumpsuits and gloves and so forth in special containers. Men wander around in their underwear, moving from showers rooms to dressing areas, and it is not unusual to see someone against a backdrop of giant turbines in plum-colored Calvin Klein jockey shorts.

Short term visitors, to the refueling areas, such as the press, wear hard hats and goggles and carry radiation measuring tools, as well as identification cards and other security devices. It takes forever to move from one part of the plant to another because radiation levels on shoes

(See page 7)

QUESTIONS FOR INCLUSION IN CONGRESSIONAL RECORD OF JAN. 7, 1988 hearing on the restart of the Pilgrim Nuclear Power Plant

submitted by Citizens Urging Responsible Energy

HEALTH ISSUE:

1. What is the reason for the State's failure to investigate Boston Edison's alleged dumping of radioactive materials on their property in Plymouth? (promised in Aug., 1987)

2. Boston Edison has admitted to dumping radioactive material at the Plymouth town dump site. Do state and federal regulations permit such action? Are not Plymouth residents exposed to radiation when using the dump?

3. Massachusetts is the nation's fifth largest producer of low-level nuclear waste. (100,000 cubic feet) What portion of that waste is generated by Pilgrim? How does that compare with similar size plants of the same design?

4. After the radioactive leaks in Nov., 1987, CURE requested that air sampling and soil testing be done by the Mass. Dept. of Public Health. The state agreed to the undertaking, but did not do it. Who decided that this was not necessary?

5. Almost 2 years have elapsed since the State promised to redo and upgrade the health study of high cancer incidence in the 5 towns downwind of Pilgrim. What is the current status of the study? Does the state feel that the issue of a possible conclusive link between adverse health effects and Pilgrim should be resolved before the plant's restart?

6. Boston Edison undertook a study of their employees' and former employees' health status. Is this study completed? Does it have preliminary findings? Will it be shared with the MDPH?

7. What were the NRC and state radiation monitoring readings in June, 1982 when highly radioactive resin was blown out a 100 ft. duct and deposited on roof tops and paved areas at Pilgrim? (all readings: onsite, stack, offsite) Was data retrieved from dosimeters at all locations?

8. CURE reported allegations to the NRC last summer regarding the removal of shrubbery onsite at Pilgrim which was said to be radioactive. The NRC said that the licensee stated the bushes were removed for security reasons. They later admitted that there was some amount of radioactivity and would investigate the matter. How do bushes at Pilgrim become radioactive? Where were they taken? Were appropriate surveys conducted?

9. NRC: Please interpret, based on the Sandia report, the expected number of deaths and casualities, long and short-term, which would result from an accident at Pilgrim. (in laymen's terms)

10. NRC: Can you provide figures on the increase of background radiation over the last 15 years? (in laymen's terms) What percentage of the increase is attributed to man-made radioactive nuclides (i.e. cesium 137, I 131, strontium 90, etc.)? Are figures available locally and nationally? What are the present figures for natural background radiation (i.e. solar rays, etc.)?

11. NRC: Has Boston Edison ever exceeded technical specifications on radioactive releases from Pilgrim? On what dates, and in what amounts over specification? Are there fines or violations associated with such releases?

QUESTIONS FOR INCLUSION IN CONGRESSIONAL RECORD OF JAN. 7, 1988 hearing on the restart of the Pilgrim Nuclear Power Plant

submitted by Citizens Urging Responsible Energy

FIRE PROTECTION:

1. Is BECO now in full compliance with Appendix R requirements in fire protection? Have they applied for any waivers?

2. Are all barriers, fire doors and penetration seals repaired and capable of passing required testing?

3. In Feb., 1986 72 locations at Pilgrim were being observed by fire watches because of unfinished maintenance in the area of fire protection. How many were being observed on Jan. 1, 1988?

4. Is the water pressure from the town of Plymouth adequate to fight a fire on the second floor of Pilgrim Station?

5. The Standby Gas Treatment deluge system has been reported to be inoperative since 1984 because it requires an outage to test it. Has this matter been resolved during the current outage? If not, why not?

6. The Halon system in the computer room is reported to have been inoperable since March, 1985 because there is no procedure to test it. Why isn't there a procedure? When will there be one?

7. What procedures are in place to suppress a fire in the computer room since the halon system in inoperative?

8. The smoke detectors over the spent fuel pool have been inaccessible to test since May, 1984. BECO is said to be investigating acquiring a compact scissors lift to test to test these and other inaccessible detectors in April, 1986. Has it been acquired? Have they been tested since that time?

9. BECO documents reveal that some outstanding maintenance requests (mrs) in the area of fire protection which were established several years ago have been assigned 1987 m.r. numbers giving the impression that they represent newly identified problems. Please list outstanding mr. in this area, and the dates each m.r. was established.

10. CURE received a report that Pilgrim's onsite fire brigade was activated to investigate the sound of a small explosion and the smell of "something burning" on Nov. 12th at the time of the power loss. Evidence has been shown to Department of Public Safety and the Senate Committee. The NRC and BECO continue to deny these reports. What procedures were used by the NRC to investigate this allegation? Did onsite NRC inspectors question employees who would have been assigned to the brigade at that time?

QUESTIONS FOR INCLUSION IN CONGRESSIONAL RECORD OF JAN. 7, 1988 hearing on the restart of the Pilgrim Nuclear Power Plant

submitted by Citizens Urging Responsible Energy

GENERAL SAFETY:

1. Did BECO shut Pilgrim down voluntarily on April 11, 1986, or did the NRC shut them down?

2. Is the Confirmatory Action Letter (CAL) still in effect?

3. Was "unusual event" the proper declaration for the emergency at Pilgrim which began on April 10, 1986? NUREG-0654, page 1-9, item 4. classifies a Main Steam Isolation valve malfunction causing leakage as an "alert declaration."

4. Was the emergency in April caused by a recurring GE design problem with the Main Steam Isolation Valves?

5. On Oct. 29, 1987 at the Duxbury forum, BECO claimed to have resolved the main steam isolation valve problems which have been identified by GE in the Reed report as unresolved generic issues. Has this resolution been shared with the NRC or GE? Is there documentation of this resolution in published form?

6. On April 4, 1986, the Residual Heat Removal (RHR) A Loop was shut down for repairs. Was the RHR A Loop repaired and operable on April 10, 1986?

7. We have noted no emergency event declarations since the shutdown in April,1986. The NRC says that declaration requirements do not apply to plants that are not operating. Why then were three inspectors dispatched to New Hampshire and Seabrook cited for a violation in procedure for not notifying the state of Massachusetts within 15 minutes of the declaration of an "unusual event"?

8. How many scrams (manual and automatic) have occurred at Pilgrim since it began operation in 1972? Do scrams contribute to core embrittlement? What is the industry average?

9. What tests have been performed to assess any potential weakening or embrittlement of the Pilgrim reactor? Who did them? What were the results? When were they done?

10. BECO has spent 30 million dollars on enhancements to their GE Mark I containment. Ten million of that amount is said to have been spent on a risk assessment study. Does the NRC have a copy of this document? Will they share it with state officials?

11. How many "substantial safety hazard" reports (or their equivalent) have been generated by Pilgrim since 1972? Please define report and list the dates and reasons for such. How does Pilgrim's average compare to similar size plants of the same design?

12. How many violations of NRC requirements have taken place at Pilgrim since 1972? How does the total compare to similar size plants of the same design?

13. On August 15, 1986, BECO notified the NRC that contrary to technical specification requirements, monitoring of the primary containment inerting system makeup flow rates had not been conducted.(said to detect any large increase in containment leakage) They further stated that instrumentation used to perform such monitoring had been out of service since January, 1985. Did the NRC cite or fine BECO for this violation of procedure? Is this instrumentation now functional?

14. Is the Standby Gas Treatment System activated by a power loss?

15. If direct torus venting were to be used, what is the range of dose rates at the exclusion zone boundary in the event of venting? At what pressure would venting take place?

16. If Pilgrim had been operating on Nov. 12, 1987, and the single operating generator had failed, did the potential exist for a core-melt accident sequence? (please answer yes or no)

In November, 1987,-
17. During the power loss CURE received a report that two pumper trucks were called onsite at Pilgrim to remove excess water from drains. The volume of water was said to be be such that it posed back up problems in the plant which would activate automatic sump pumps; thereby drawing additional electricity from the single operating generator. If the system had not been pumped out before the pumps engaged, would an emergency evacuation have occurred? Was the NRC informed of this incident? Was the waste water contaminated? Was it tested? Where was it taken?

QUESTIONS FOR INCLUSION IN CONGRESSIONAL RECORD OF JAN. 7, 1988 hearing on the restart of the Pilgrim Nuclear Power Plant

submitted by Citizens Urging Responsible Energy

EMERGENCY PLANNING: NRC, FEMA and State Officials

1. What agency is liable for damages incurred as a result of an improperly implemented evacuation plan?

2. If a radioactive plume can travel 10 miles per hour, how can people evacuate to a proper shelter under adverse weather conditions?

3. Is it true that the planning for the health and safety of residents in the EPZ is not based on a worst case scenario event?

4. Does Duxbury need a 3rd reception center to decontaminate evacuees?

5. BECO'S KLD time estimate study indicates that during a major snowstorm, 50% of all driveways will be plowed within 30 minutes. What is the basis for that judgement?

6. NRC: define explicitly the role FEMA'S judgement will play in determining the "adequacy" they claim will be required in emergency planning before they will grant permission for restart.

7. FEMA announced withdrawal of approval of Pilgrim's evacuation plan on August 6, 1987. The NRC has now exceeded the 120-day period to make a decision regarding FEMA'S negative findings. When will that decision be made?

8. Why has BECO'S Bus Shelter Survey not been made available to communities in the EPZ?

9. FEMA declined to participate in a forum sponsored by the the Duxbury Board of Selectmen on Oct. 29, 1987 because of a prior commitment and said their staff's time was consumed with the Seabrook issue. Does FEMA give preference to licensing over safety issues?

10. What provisions have been made to segregate the prisoners at the Plymouth County House of Correction from other people evacuating in the case of an emergency at Pilgrim?

11. Will the NRC make a restart decision regarding evacuation planning on potential solutions proposed by BECO, or on completed plans which have been verified with letters of agreement and approved by the local communities and the Commonwealth of Massachusetts?

The CHAIRMAN. Dr. Healy.

Dr. HEALY. Thank you, Mr. Chairman.

The Plymouth Committee on Nuclear Matters, formally constituted by the Board of Selectmen on August 19, 1986, consists of nine members of diverse backgrounds and experience, with expertise in the medical and legal fields; in business and industry, including the utilities; in physics and engineering, in planning and in public policy.

The committee members while differing sometimes radically in their opinions have one common passion, that of the discovery of what is fact. We have done our best to put aside our individual biases in order to listen to knowledgeable others.

Thus far, the committee has issued two reports. The first on the Plymouth Radiological Emergency Response Plan; the second on Environmental Radiation Monitoring. In the first report, we said the following in March 1987:

There are deficiencies in the Plymouth Radiological Emergency Response Plan which are serious enough in the committee's judgment to preclude reasonable assurance that adequate protective measures can and will be taken by the town and the state in the event of a radiological emergency.

Hence, the committee made the following recommendations:

1. That there be a comprehensive revision of the Plymouth Radiological Emergency Response Plan. This task is incomplete.

2. That there be an appointment made of a full-time civil defense director. That individual will begin on January 11, next Monday.

3. Development of funds for emergency preparedness from Federal, State and utility sources. The only funds forthcoming have been from Boston Edison.

4. Full town participation in a comprehensive drill prior to Pilgrim's coming back on-line. This has not been done.

Regarding the second committee report, the Committee on Nuclear Matters is strongly concerned with what it considers to be the insufficient number of monitoring stations, the minimal and perfunctory involvement of the State in the monitory process and the complete lack of an oversight monitoring system.

All of the many reports reviewed by the Committee on Nuclear Matters indicate to its members that the Pilgrim nuclear power plant does have a continuing environmental impact. In all the materials reviewed, however, Edison, NRC and the Commonwealth hold that offsite releases from the plant, as indicated by current monitoring, have not exceeded technical specifications.

Boston Edison Co., the NRC and the Commonwealth then draw the conclusion that there has been no measurable impact upon the citizenry. They further claim that even if there had been any impact, it would have been minimal and far less than the effects of previous worldwide weapons testing or of the Chernobyl accident.

The Committee on Nuclear Matters takes little comfort in the above comparisons. Any environmental impact is our concern and needs to be examined. Let us not forget that the impact of such effects is cumulative. The committee questions the adequacy of current monitoring around Pilgrim I, even though it is more extensive than that at some other nuclear plants.

Hence, the committee recommends increased monitoring, higher quality monitoring, proper timing of monitoring to reveal effects of specific plant incidences which involve radioactive releases and prompt reporting of the results. Accomplishment of these recommendations is basic to an investigation of the impact of the station upon citizens' health; an investigation which has yet to be accomplished.

We respectfully request your assistance, Mr. Chairman, on two related matters which may not be the direct concern of your committee. We request that you exert your considerable leadership at the national level to help mitigate the unintended, negative consequences of past congressional action and inaction which have led to America's hometown becoming, in fact, a high level nuclear dump site. We beg you to assist in relieving us of this burden. Only Congress can do it, not the utilities and not Boston Edison.

We ask that you monitor closely the progress of the Department of Energy's work at the Yucca Mountain drilling site in Nevada to insure that the nation will obtain as soon as possible a long, overdue, permanent repository for high level nuclear waste.

We also respectfully suggest that you help to initiate a congressional review of the role and the performance of the Nuclear Regulatory Commission, and reasserting of congressional authority relative to the nuclear industry. It is needed. We request that you introduce corrective legislation which will ensure congressional authority and responsibility.

Thank you very much for this opportunity, Mr. Chairman. It is deeply appreciated. I shall be happy to answer any questions insofar as I am able.

[The prepared statement of Dr. Healy (with attachments) follows:]

TESTIMONY BEFORE THE LABOR AND HUMAN RESOURCES COMMITTEE

OF THE UNITED STATES SENATE

(Senator Edward M. Kennedy, Committee Chairman)

By Dr. Grace M. Healy, Chairman

COMMITTEE ON NUCLEAR MATTERS

TOWN OF PLYMOUTH, MASSACHUSETTS

Thursday, January 7, 1988

The Plymouth Committee on Nuclear Matters, formally constituted by the Board of Selectmen on August 19, 1986, consists of nine members of diverse backgrounds and experience with expertise in the medical and legal fields, in business and industry including the utilities, in physics and engineering, in planning, and in public policy.

The Committee members, while differing sometimes radically in their opinions, have one common passion - that of the discovery of what is <u>fact</u>. We have done our best to put aside our individual biases in order to listen to knowledgeable others. We have researched facts, gathering available information from voluminous written materials and reports, from interviews of relevant parties and from public hearings. We have visited the plant, participated in simulated emergency and training drills, consulted with technical experts and deliberated with one another during lengthy committee meetings.

Our deliberations have, at times, been difficult. In the end, we have managed to reach consensus on most recommendations. It is clear that we stand together in our concern for the safety of all residents of Plymouth.

Thus far the Committee has issued two Reports: the first on the Plymouth Radiological Emergency Response Plan; the second on Environmental Radiation Monitoring. In the first report we said the following in March 1987:

There are deficiencies in the Plymouth Radiological Emergency Response Plan which are serious enough, in the Committee's judgment, to preclude "... reasonable assurance that adequate protective measures can and will be taken (by the Town and State) in the event of a Radiological Emergency." There is reason to believe that as things stand now, the Selectmen cannot fulfill their legal responsibility, particularly during a Radiological Emergency, ".... to provide for the health and safety of persons and their property ...."

The Plymouth Radiological Emergency Response Plan is a "paper" plan, essentially untested relative to mobilization of some of the essential personnel. Hence, the Committee made the following recommendations:

1. Comprehensive revision of the Plymouth Radiological Emergency Response Plan.
   <u>This task is not complete.</u>

2. Appointment of a full-time Civil Defense Director, with staff as needed, with adequate interim headquarters, and with long-term plans for location in one of the new Town buildings.
The Civil Defense Director will begin work on January 11, 1988.

3. Development of funds for emergency preparedness from federal, state and utility sources.
Only funds from Boston Edison are being made available to the Town.

4. Full Town participation in a comprehensive drill prior to Pilgrim's coming back on-line.
This has not been done.

The Committee holds that the Plan must be operationalized. Procedures must be specified and tested. Commitments of personnel and materials must be legally formalized. Anything less is unacceptable.

Regarding the second Committee Report:

The Committee on Nuclear Matters, in an attempt to understand the monitoring of environmental radiation associated with the Pilgrim Nuclear Power Station, reviewed documents provided by Boston Edison and interviewed knowledgeable persons, including but not limited to Boston Edison representatives, Nuclear Industry representatives, Department of Public Health representatives and State Officials.

The Committee on Nuclear Matters is strongly concerned with what it considers to be the insufficient number of monitoring stations, the minimal involvement of the State in the monitoring process, and the complete lack of an "oversight" monitoring system.

All of the Reports reviewed by the Committee on Nuclear Matters (1982-1987) indicate to its members that the Pilgrim Nuclear Power Plant does have a continuing environmental impact. In all of the materials reviewed, however, Boston Edison Company, the N.R.C., and the Commonwealth hold that offsite releases from the Plant (as indicated by current monitoring) have not exceeded technical specifications. Boston Edison Company, the N.R.C., and the Commonwealth then draw the conclusion that there has been no measurable impact upon the citizenry. They further claim that even if there had been any impact it would have been minimal, and far less than the effects of previous worldwide weapons testing or of the Chernobyl accident.

The Committee on Nuclear Matters takes little comfort in the above comparisons. Any environmental impact is of concern and needs to be examined if public health is to be protected. Let us not forget that the impast of such effects is cumulative! The Committee questions the adequacy of current monitoring around Pilgrim I, even though it is more extensive than that at some other nuclear plants. Hence, the Committee recommends increased monitoring, higher quality monitoring, proper timing of monitoring to reveal effects of specific plant incidences which involve radioactive releases, and prompt reporting of the results. Accomplishment of these recommendations is basic to an investigation of the impact of PNPS upon citizens' health. . . an investigation which has yet to be accomplished.

The two Committee Reports mentioned here are being made available to your staff, Mr. Chairman, as will be future reports and recommendations from our Committee.

We respectfully request your assistance on two related matters which may not be the direct concern of your Committee. We request that you exert your considerable leadership at the national level to help mitigate the unintended negative consequences of past Congressional action and inaction which have led to America's Home Town becoming, in fact a high level nuclear dump site. We beg you to assist in relieving us of this burden. Only Congress can do it, not the utilities - not Boston Edison.

We ask that you monitor closely the progress of the Department of Energy's work at the Yucca Mountain drilling site in Nevada to insure that the nation will obtain as soon as possible a permanent repository for high level nuclear waste.

We also respectfully suggest that you help to initiate a Congressional review of the role and performance of the Nuclear Regulatory Commission, and the reasserting of Congressional authority relative to the Nuclear Industry. If it is needed, we request that you introduce corrective legislation which will ensure Congressional authority and responsibility.

Thank you very much for this opportunity, Mr. Chairman; it is deeply appreciated. I shall be happy to answer any of your questions insofar as I am able.

TOWN OF PLYMOUTH

COMMITTEE ON NUCLEAR MATTERS

REPORT TO THE SELECTMEN

ON

THE PLYMOUTH RADIOLOGICAL EMERGENCY RESPONSE PLAN

March, 1987

THE COMMITTEE ON NUCLEAR MATTERS

MEMBERS:

Grace M. Healy, Chair
Charles W. Adey, Vice-Chair
Ann Waitkus Arnold
Theodore L. Bosen
Marie P. Fehlow
Kenneth T. Holmes
Kathleen M. Leslie
Anthony V. Lonardo
John P. Rooney
James W. Ryan
Howard E. Shetterly

SUBCOMMITTEE MEMBERS:

Ann Waitkus Arnold
Kenneth T. Holmes

TOWN OF PLYMOUTH

THE RADIOLOGICAL EMERGENCY RESPONSE PLAN

INTRODUCTION

As one of its tasks, the Committee on Nuclear Matters assumed responsibility for a review of the Plymouth Radiological Emergency Response Plan (RERP). The following is the result of research undertaken by the subcommittee, and of the deliberations of the entire committee.

In order to determine Plan adequacy and feasibility, information was sought from many sources. Subcommittee members reviewed written materials: other Emergency Response Plans (ERP); Federal Emergency Management Agency (FEMA) Regulations; reports on the adequacy of various RERP's; testimony of public interest groups, and one available section of Secretary Barry's report. Subcommittee members also contacted, in person and by telephone, representatives from: (1) Local, Regional and State Civil Defense Offices, (2) FEMA, (3) various Town Offices; (4) State Office of Handicapped Affairs; and (5) Boston Edison.

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

There are deficiencies in the Plymouth RERP. Moreover, these deficiencies are serious enough, in the Committee's judgment, to preclude "... reasonable assurance that adequate protective measures can and will be taken (by the Town and State) in the event of a Radiological Emergency." There is reason to believe that as things stand now, the Selectmen cannot fulfill their legal responsibility, particularly during a Radiological Emergency, ".... to provide for the health and safety of persons and their property ...."

The Plymouth RERP is a "paper" plan, essentially untested relative to mobilization of some of the essential personnel. As long as it is untested, difficult questions can remain unanswered and difficult decisions can be avoided. This is a situation unacceptable to the members of the committee. Thus, we respectfully urge Selectmen to assign tasks and timelines to appropriate personnel and/or offices to ensure accomplishment of the following:

A. Comprehensive revision of the Plymouth RERP.
   1. Correction of outdated information.
   2. Elimination of specific deficiencies noted below.
   3. Complete specification of implementation procedures.
   4. Specification of procedures for ongoing updating and coordination with local, area, and state plans.

B. Appointment of a full-time Civil Defense Director, with staff as needed, with adequate interim headquarters, and with long-term plans for location in one of the new Town buildings.

C. Development of funds for emergency preparedness from federal, state and utility sources. (Appointment of liaison for same.)

D. Full Town participation in a comprehensive drill prior to Pilgrim's coming back on-line. (While actual citizen evacuation may not be feasible, full participation must at least include all responsible personnel being in-place and carrying out assigned tasks.) Coordination of agencies, their services and lines of responsibility - local, state, federal levels must be tested.

The Committee further recommends that all deficiencies be remedied and all recommendations be implemented prior to reactor start-up.

There was one dissenting opinion expressed concerning the above. The objection relates to making total task accomplishment a condition for reactor start-up when longer time may be required for some tasks. The dissenting opinion does not represent disagreement on deficiencies or recommendations, but on timelines. In all cases there is agreement on need and urgency for action.

SPECIFIC DEFICIENCIES AND RECOMMENDATIONS

Following are specific deficiencies found by the Committee on Nuclear Matters and some recommended corrective measures; they have been grouped in eight categories: (A) Advance Information, (B) Notification and Communication Systems, (C) Evacuation Routes, (D) Evacuation Time Estimates, (E) Transport of Dependent Populations, (F) Reception Centers and Public Shelters, (G) Medical Facilities, and (H) Radioprotective Drugs.

A. ADVANCE INFORMATION

DEFICIENCIES:

1. Inadequate public information in Emergency Preparedness Zone (EPZ).
2. Lack of multi-lingual information (Italian, Portuguese, Spanish, Japanese).
3. Inadequate distribution of Emergency Preparedness Information (EPI) brochures.
4. No information for people without access to transportation.
5. No information about staging areas (pick-up points).
6. Tourist and transient information inadequate or non-existent.
7. No educational effort outside the Town of Plymouth.

ADVANCE INFORMATION (Continued)

RECOMMENDATIONS:

1. Implement a comprehensive, ongoing public educational program through news ads, cable TV programs, radio public service announcements, and informational packets included in utility bills. Include an outreach program for non-English speaking people in these activities.

2. Develop emergency information posters (multi-lingual), with maps explaining:

   - Protective Actions
   - Evacuation Routes
   - Location of Public Shelters
   - Location of Public Transportation
   - Local Radio Station of EBS
   - Staging Area Locations

3. Post Emergency Information Posters in public locations:

   Hotels, motels, restaurants, gas stations, phone booths, recreation facilities, tourist sites, informational centers, theaters, airports, bus stations, trolley cars, and all public buildings.

4. Develop survey to identify special populations:

   a. Non-English speaking people.
   b. Transport dependent groups:
      - 15% of Plymouth households have no car;
      - 50% of households have one car, but one half of workers have jobs outside of Plymouth.
   c. Special needs people:
      - Federal regulations require notification of "all segments of society."
      - Deaf and hard-of-hearing people must be identified beforehand so they can be alerted by appropriate means.

5. Distribute updated pamphlets semi-annually to:

   - General public and all recommended locations in #3 above.
   - Multi-lingual pamphlets should be available in the same places.

B. NOTIFICATION AND COMMUNICATION SYSTEMS

DEFICIENCIES:

1. Siren System

   a. The siren system is not equipped to confirm that all sirens have been sounded during an exercise. There are no provisions for determining which sirens are not working.
   b. Present siren system does not warn hearing-impaired persons. No alternate plan exists to notify this segment of the population.

2. Radio Communications

   a. Department of Public Works radio equipment used for Civil Defense is unreliable and inadequate.
   b. Present system for notifying local officials is unreliable.
   c. Plymouth County radio network (Sheriff's) is inadequate/inefficient.

RECOMMENDATIONS:

ALL PROCEDURES FOR NOTIFICATION OF AN ACCIDENT AT PILGRIM I SHOULD BE REVIEWED.

1. Investigate the "hard-wire" system or other alternatives that confirm siren activation. Alert officials who will dispatch personnel to areas with defective sirens to activate sirens manually and to warn public from vehicles and loudspeakers.

2. Develop procedures to confirm activation of every siren. Specify numbers of vehicles and personnel required for #1 above.

3. Test sirens weekly on the same day and at the same time.

4. Identify hearing impaired people and install telecommunication devices.

5. Provide closed captioning for the Emergency Broadcasting System.

6. Install tone alert radios in every school bus, transport vehicle, and other vehicle specially licensed to transport children, the elderly, and handicapped persons in the Emergency Preparedness Zone.

7. Upgrade Plymouth County Radio network hardware. Test the hardware on a regular basis.

C. EVACUATION ROUTES - LIMITED ACCESS AND EGRESS

DEFICIENCIES:

1. Proposed routes (Routes 3 and 44) are completely inadequate for effective handling of anticipated volume of traffic. Traffic is already jammed due to the heavy volume of tourists in the summer months, and during heavy winter storms, or when roads are under construction or repair.

2. Voluntary evacuation (Evacuation Shadow Phenomenon) is not taken into account.

RECOMMENDATIONS:

The following are not remedial; they simply address worsening of the problem.

1. New development along evacuation routes should require an impact study by developers with specifications set by appropriate Town Offices. The study should be reviewed by the Planning Committee.

2. Prior to approval of road construction/repair (along evacuation routes) the appropriate Town Office must make an impact assessment and develop alternative routes.

D. EVACUATION TIME ESTIMATES

DEFICIENCIES:

1. Present time estimates are based on outdated information and have major flaws.

2. Evacuation Time Estimates (ETE) is based on several questionable assumptions:

   a. It assumes there will be no mass voluntary evacuation not in planned boundaries (shadow-phenomenon) as occurred at Three Mile Island, which could cause major route blockage and back-ups.
   b. It assumes that emergency personnel will remain in place and not evacuate with their families.
   c. It assumes that communities outside the Ten Mile EPZ have developed adequate plans to augment evacuation and sheltering efforts, although Massachusetts Civil Defense Agency (MCDA) states no such plan exists.
   d. It assumes the timely presence of State Police and National Guard.

3. Large discrepancies exist between Boston Edison and the Nuclear Regulatory Commission (NRC) ETE's.

EVACUATION TIME ESTIMATES (Continued)

4. Panic and traffic disorder have not been adequately considered:

   a. Blocking of cross streets
   b. Disregard of traffic signals
   c. Driving in left hand lane
   d. Abandoned vehicles
   e. Driver confusion
   f. Failure of traffic control
   g. Accidents

   These considerations plus ineffective traffic control could result in more than a 50% reduction in traffic flow, which would mean the evacuation time could be more than doubled.

5. No adequate estimates for time required to evacuate non-car-owning people dependent on public transport.

6. Estimates of the number of vehicles at public beaches is inadequate.

7. Estimates required by federal regulations are lacking.
   a. Separate times for adverse weather - fog, rain, flooding, snow, storms.
   b. Day versus night, workday versus weekend, peak transient versus non-peak transient, and evacuation versus non-evacuation in adjacent sectors.
   c. Separate estimates for "special population groups" on an "institution by institution" basis (e.g., schools, hospitals, nursing homes, correctional facilities).

RECOMMENDATIONS:

1. The new Boston Edison Company (BECo) ETE's must:
   a. be based on realistic assumptions,
   b. include all specific time estimates required by FEMA,
   c. take into account mass voluntary evacuation consequences,
   d. address previously stated shortcomings.

2. The new ETE must be completed prior to plant operation.

3. Documentation should be provided by BECo to assure the ETE's provide a workable means to evacuate <u>all</u> residents of the EPZ based on a wide range of accident scenarios.

E. PLANS TO TRANSPORT DEPENDENT POPULATION

(People without access to cars, school children and children in day care, hospital and nursing home residents, handicapped persons, campers, persons in correctional institutions.)

DEFICIENCIES:

1. Numbers of vehicles needed and sources for them have not been analyzed.

2. No contracts or letters of agreement have been signed with MBTA, bus companies, drivers, ambulance companies, and other entities providing public transportation and personnel support for the plan.

3. There are no particular plans for evacuating handicapped people. This segment of the population has not even been identified.

4. Plans call for individuals to make arrangements with local CD for transportation. Local CD will then contact MCDA Area II for assistance; however, the Area II plan does not contain information on how to procure additional transportation.

5. Schools - There are no separate plans or procedures for each school and day care center. Bus companies and drivers have not signed agreements to perform during an evacuation. The school plan lacks detailed procedures. Estimated time to mobilize National Guard for schools is three hours, and Guardsmen may not be familiar with road network.

RECOMMENDATIONS:

1. Conduct a survey to determine transportation needs of all people dependent on public transportation in all sectors of EPZ. Provide specific and separate information for summer/non-summer, weekday/weekend populations.

2. Document available resources and resource needs, such as transportation contractors, trained personnel, drivers trained in emergency response procedures, special care personnel and equipment for disabled persons.

3. Obtain written agreements with transportation contractors and drivers.

4. Develop specific, adequate plans to evacuate each dependent group, such as the population in nursing homes, hospitals, schools, camps, residential homes, correctional institutions, day care centers.

5. Provide for special needs population - physically and mentally handicapped people:
   a. Provide notification in advance of special evacuation procedures for disabled people;
   b. Plan for delivery of necessary services during an emergency with trained assistance for each handicapped person designated beforehand;
   c. Provide beepers, backup personnel for vacation times, special equipment and medications.

F. RECEPTION CENTERS AND SHELTERS

Bridgewater State College and Taunton State Hospital

DEFICIENCIES:

1. There are no clearly defined functions for the reception centers and shelters.

2. There are no letters of agreement, or contracts with reception centers. (Who provides what and who pays?)

3. There are no adequate plans, equipment, supplies or personnel to implement purposes for reception centers. (Such as contamination monitering, decontamination, congregate care, ...)

4. Public shelter locations are not identified.

5. Adequate plans for public shelters are non-existent (personnel, supplies, etc.)

6. Resettlement and/or reentry plans have not been formulated.

7. The option of sheltering in private homes versus evacuation is not addressed.

RECOMMENDATIONS:

1. Define specific and separate functions for public shelters and reception centers.

2. Specify conditions for which sheltering in private homes might be preferable to evacuation.

3. Conduct survey of potential shelters adequate to accommodate peak summer populations.

4. Identify and contract for an adequate number of reception centers and public shelters to accommodate EPZ population.

5. Provide adequate plans for equipment, supplies and personnel for centers and shelters.

G. MEDICAL FACILITIES

DEFICIENCIES:

1. There are inadequate plans for treating large numbers of victims of radiation exposure.

2. The two hospitals listed in the Plan (Jordan and St. Luke's) can treat only a limited number of people with radioactive contamination.

3. One hospital is within the EPZ and could be simultaneously receiving and evacuating patients.

RECOMMENDATIONS:

1. Clearly determine response capacity of Jordan and St. Luke's Hospitals.

2. Identify all possible referral hospitals outside EPZ.

3. Document capacity, types of care and provisions available at referral hospitals outside EPZ.

4. Obtain signed agreements with referral hospitals.

5. Develop procedures for transportation of patients outside the EPZ.

H. RADIOPROTECTIVE DRUGS

PRESENT POLICY:

The Massachusetts Department of Public Health does not advise distribution to the general public of Potassium Iodide (KI) as a radioprotective drug.

RECOMMENDATION:

That the Department of Public Health provide for the distribution of Potassium Iodide or a proven alternative to the general Plymouth population prior to reactor start-up.

In conclusion, the Committee notes, once again, that the deficiencies identified herein and the recommendations made relative to the Plymouth RERP are by no means exhaustive or all-inclusive. Those listed are, however, serious enough that, were they not to be addressed, the selectmen might be unable to "... provide for the health and safety of persons and their property ..." during a radiological emergency. Hence, the Committee respectfully urges the Selectmen to give immediate attention to the matters contained in this report. Even after the current revision of the RERP and the implementation of recommendations, regular monitoring by the Town will be needed so that improvements in the plan may be made as they become necessary.

TOWN OF PLYMOUTH

COMMITTEE ON NUCLEAR MATTERS

COMMITTEE REPORT

ENVIRONMENTAL RADIATION MONITORING

PILGRIM NUCLEAR POWER STATION

December 1987

COMMITTEE MEMBERS:

Grace M. Healy, Chair
Charles W. Adey, Vice-Chair
Ann Waitkus Arnold
Theodore L. Bosen
Marie P. Fehlow
Kathleen M. Leslie
Anthony V. Lonardo
John P. Rooney
Howard E. Shetterly

SUBCOMMITTEE MEMBERS:

Kathleen M. Leslie, M.D.
Marie P. Fehlow, R.N.

The Committee thanks Mrs. Pauline M. Howe for her invaluable assistance in editing and typing this Report.

REPORT ON
PILGRIM NUCLEAR POWER STATION
ENVIRONMENTAL RADIATION MONITORING

OVERVIEW

The Committee on Nuclear Matters, in an attempt to understand the monitoring of environmental radiation associated with the Pilgrim Nuclear Power Station, reviewed documents provided by Boston Edison and interviewed knowledgeable persons, including but not limited to Boston Edison representatives, Nuclear Industry representatives, Department of Public Health representatives and State Officials.

The Committee on Nuclear Matters is strongly concerned with what it considers to be the insufficient number of monitoring stations, the minimal involvement of the State in the monitoring process, and the complete lack of an "oversight" monitoring system.

The Committee respectfully urges the Selectmen to consider well these recommendations and to request both Boston Edison Company and the Commonwealth of Massachusetts to act expeditiously on these recommendations, which the Committee considers to be basic and modest.

INTRODUCTION

This document contains Committee recommendations, with a sampling of the pertinent materials reviewed. The latter are intended to provide some background for the recommendations made herein.

There are two sections in this document:

Section I: Summary, Conclusions and Recommendations

Section II: Background Materials

* Excerpts from PNPS-1 Environmental Monitoring Program Reports Numbers 15, 17, 18.

* Excerpts from PNPS-1 Environmental Monitoring Program Report Number 19 and Radioactive Effluent and Waste Disposal Report January - June 1987.

* Department of Public Health Monitoring Program.

* Glossary

It should be noted that Section II is only an outline of "Findings." The reader is referred to the complete Boston Edison Program Reports, which are available at the Plymouth Public Library.

SECTION I

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

RADIATION MONITORING AND THE PILGRIM NUCLEAR POWER STATION

SUMMARY

1) The presence of Pilgrim Nuclear Power Station (PNPS)-related isotopes has been documented offsite in shellfish, ocean fish, algae, ocean floor sediment, and garden produce. In addition, PNPS-related isotopes are present in water samples from the discharge canal, and a single isotope, H-3 (Tritium), has been found in a nearby pond. Onsite locations that monitor for airborne radiation are positive for Co-60 (Cobalt).*

2) Environmental radiation monitoring:

   a) Airborne radiation is measured weekly for beta particles, quarterly for gamma radiation.

   b) Thermoluminescent Dosimeters (TLDs), which monitor gamma radiation, are analyzed quarterly.

   c) Liquid effluent from the plant's discharge canal is analyzed weekly by Boston Edison and monitored weekly by the Department of Health (DPH).

   d) Stack monitors which record gaseous, particulate, and Iodine (I-131) releases from PNPS are reviewed weekly by the DPH and analyzed weekly by Boston Edison.

3) Monitoring data are made available to the public in the local library six months after the year ends. (Environmental Radiation Monitoring Program Report.)

4) The NRC has faulted Boston Edison's TLD program in the SALP Report for November 1, 1985 through January 31, 1987:

> "... problems were identified in the licensee's environmental thermoluminescent dosimeter (TLD) program. Commitments made by the licensee during previous assessment periods to improve the environmental TLD program were not implemented. Because of these problems, the validity of the environmental TLD data cannot be assured. This indicated lack of management involvement in this area and a lack of understanding and thoroughness with regard to resolution of technical issues."

5) Monitoring of residential areas contiguous to the plant is virtually non-existent.

6) The DPH, NRC, and Boston Edison do not react quickly enough and strongly enough, with additional monitoring -- particularly offsite, when there are unplanned radiation releases.

* Throughout this report, symbols such as Co^{60}, are written as Co-60. This representation is used extensively in Boston Edison and State reports and in non-technical informational materials.

CONCLUSIONS

All of the Reports reviewed by the Committee on Nuclear Matters (1982-1987) indicate to its members that the Pilgrim Nuclear Power Plant does have a continuing environmental impact. In all of the materials reviewed, however, Boston Edison Company, the N.R.C., and the Commonwealth hold that offsite releases from the Plant (as indicated by current monitoring) have not exceeded technical specifications. Boston Edison Company, the N.R.C., and the Commonwealth then draw the conclusion that there has been no measurable impact upon the citizenry. They further claim that even if there had been any impact it would have been minimal, and far less than the effects of previous worldwide weapons testing or of the Chernobyl accident.

The Committee on Nuclear Matters takes little comfort in the above comparisons. Any environmental impact is of concern and needs to be examined if public health is to be protected. The Committee questions the adequacy of current monitoring around Pilgrim I, even though it may be more extensive than that at some other nuclear plants. Hence, the Committee recommends increased monitoring, higher quality monitoring, proper timing of monitoring to reveal effects of specific plant incidences which involve radioactive releases, and prompt reporting of the results. Accomplishment of these recommendations is basic to an investigation of the impact of PNPS upon citizens′ health.

RECOMMENDATIONS

1. The Commonwealth of Massachusetts should establish a comprehensive, state-of-the-art radioactive monitoring system, the purpose of which is to measure instantaneously the type and quantity of radioactive emissions and effluents at each release point of nuclear reactors. The intent of the Committee in this recommendation is the establishment of an independent monitoring (oversight) system which will go far beyond the minimum monitoring now done by the Department of Public Health.

2. Such a system will require substantial resources. To that end, the owners of nuclear power plants within the Commonwealth of Massachusetts should be assessed the costs of establishing and operating the comprehensive, state-of-the-art monitoring system.

3. Since an extended time period will be involved in bringing this comprehensive monitoring system on line, the following <u>immediate</u> response is recommended:

   As an interim measure, the committee recommends that a <u>qualified</u> state team should be established <u>as soon as possible</u> to monitor plant activities relative to radiological releases which affect the well-being of the citizenry. This team will be <u>located onsite</u> and report to appropriate State decision makers. This will not be a continuing arrangement, but merely a first step toward the <u>permanent</u> system specified in recommendation number 1.

4. Boston Edison should increase its air particulate, gaseous radioiodine and soil surveillance stations. These additional stations should be adequate to ensure that no substantial radioactive material can be released without detection.

5. Boston Edison should install additional TLD's around the Plant to ensure <u>reliable</u> quantification of total offsite dose rate.

6. Boston Edison should increase the numbers of samples collected and the locations and frequency of collection of shellfish.

7. Boston Edison should improve quality control with respect to its radiation monitoring so that equipment failure is immediately recognized.

SECTION II

BACKGROUND MATERIALS

PILGRIM NUCLEAR POWER STATION
ENVIRONMENTAL RADIATION MONITORING PROGRAM

Excerpts from REPORT NO. 18 (1985), REPORT NO. 17 (1984) and REPORT NO. 15 (1982).

ENVIRONMENTAL RADIATION

A. AIRBORNE

Airborne radiation is monitored at the locations listed by Boston Edison in table 4.8.2. of Report #18. (See the following page.) Particulates, radioiodine, and soil are sampled. The collection system consists of a cellulose particulate filter and a charcoal filter cartridge which are used to collect particulate matter and iodine nuclides respectively. Analyses of the particulate filters for beta radiation is performed weekly. I-131 analyses are performed weekly as well. In addition quarterly composite particulate samples are tested for gamma emitting nuclides. Soil analyses are performed once per three years for gamma isotopes.

FINDING

Cobalt (Co-60), attributed to operation of PNPS, has been found at onsite locations including the overlook, pedestrian bridge, and warehouse. It has been identified in the soil at the pedestrian bridge.

B. DIRECT

Dosimeters, located at twenty areas (as listed in table 4.8.3) are analyzed on a quarterly basis for gamma radiation.

FINDING

According to Boston Edison, "beyond the ′exclusion area′ (for this purpose, the 0.25-0.7 mile region), dose rates show no significant plant effect....."[1]

1 Environmental Radiation Monitoring Program, Report No. 18 (1985), pp. 3-16, 3-17.

TABLE 4.8.2

AIR PARTICULATES, GASEOUS RADIOIODINE AND SOIL SURVEILLANCE STATIONS

Sampling Location (Sample Designation)	Distance and Direction from Reactor
Offsite Stations	
East Weymouth (EW) *	23 miles NW *
Plymouth Center (PC)	4.5 miles W-WNW
Manomet Substation (MS)	2.5 miles SE
Cleft Rock Area (CR)	0.9 miles S
Onsite Stations	
Rocky Hill Road (ER)	0.8 miles SE
Rocky Hill Road (WR)	0.3 miles W-WNW
Overlook Area (OA)	0.03 miles W
Property Line (PL)	0.34 miles NW
Pedestrian Bridge (PB)	0.14 miles N
East Breakwater (EB)	0.35 miles ESE
Warehouse (WS)	0.03 miles SSE

TABLE 4.8.3

EXTERNAL GAMMA EXPOSURE SURVEILLANCE STATIONS (TLD)

Dosimeter Location (Designation)	Distance and Direction from Station
Offsite Stations	
East Weymouth (EW) *	23 miles NW *
Kingston (KS)	10 Miles WNW
Sagamore (CS)	10 miles SSE-S
Plymouth Airport (SA)	8 miles WSW
North Plymouth (NP)	5.5 miles WNW
Plymouth Center (PC)	4.5 miles W-WNW
South Plymouth (SP)	3 miles WSW
Manomet (MS)	2.5 miles SSE
Manomet (ME)	2.5 miles SE
Manomet (MP)	2.25 miles ESE-S
Cleft Rock Area (CR)	0.9 miles S
Saquish Neck (SN) **	4.6 Miles NNW ***
Onsite Stations	
Rocky Hill Road (ER)	0.8 miles SE
Microwave Tower (MT)	0.38 miles S
Rocky Hill Road (WR)	0.3 miles W-WNW
Rocky Hill Road (B)	0.26 miles SSE
Property Line (H)	0.21 miles SSW
Property Line (I)	0.14 miles W
Public Parking Area (PA)	0.07 miles N-NNE
Overlook Area (OA)	0.03 miles W

* Control Station
** TLD's for this location will be provided to a third party and will be analyzed for gamma exposure whenever returned to BECo.
*** Supplemental provision

C. WATERBORNE

Waterborne radiation is monitored at the plant's discharge canal, at Bartlett Pond (which is 1.7 miles SE of the plant) and at Powder Point Bridge (which is 7.8 miles NNW of the plant). Discharge canal samples are collected every one-half hour; weekly "grab samples" are taken from the Bartlett Pond and from Powder Point Bridge seawater. Analysis is monthly for gamma isotopes and quarterly for H-3.

FINDING

Cesium (Cs-137), Cobalt (Co-60), and Tritium (H-3) have been present in discharge canal samples. H-3 has been found at Bartlett Pond. These isotopes, according to Boston Edison, are attributed to operation of PNPS.

D. AQUATIC

Aquatic samples include shellfish, Irish moss (algae), lobster, fish and ocean floor sediments.

1. Shellfish
   Shellfish samples are analyzed quarterly for gamma isotopes. Locations sampled are discharge outfall, Duxbury Bay, Manomet Point, Plymouth or Kingston Harbor, and Marshfield.

   FINDING

   Samples from the discharge canal have been positive for Mn-54, Zn-65, Co-60, Co-58, and Cs-137. Samples from Manomet Point have been positive for Mn-54, Co-60, Cs-137, Zn-65. Testing for Co-60, Cs-137 has been positive in Warren Cove samples. According to Boston Edison, all of these isotopes are attributable to operation of PNPS.

2. Algae
   Algae samples are collected quarterly from the discharge canal, Manomet Point, and Ellisville.

   FINDING

   Samples from the discharge canal have demonstrated Zn-65, Cs-137, Mn-54, Co-58 and Co-60. Algae from Manomet Point have demonstrated Mn-54 and Co-60. Ellisville has been positive for Mn-54 and Co-60. According to Boston Edison, all of these isotopes are attributable to operation of PNPS.

3. Lobster
   Lobster is collected four times per season in the vicinity of discharge point and annually offshore. It is analyzed for gamma isotopes.

   FINDING

   No plant attributable isotopes were found.

4. Fish
Gamma isotopic analyses are performed from four separate fish groups: bottom oriented, near bottom, anadromous, and coastal migratory. They are caught in the vicinity of the discharge canal as well as at a control point at a distance offshore. Analysis is quarterly for bottom and near bottom fish, in season for anadromous and coastal migratory. A control analysis from fish caught offshore is performed annually.

FINDING

Bluefish and cod samples from the discharge canal have been positive for Cs-137. A salmon sample from the mouth of the North River in Hanover was positive for Cs-137. This isotope was attributed by Boston Edison as being due to radioactive releases from PNPS.

5. Sediments
Sediment samples are taken semi-annually at Rocky Point, Warren Cove, Plymouth Harbor, Duxbury Bay, Plymouth Beach, Manomet Point, and a control point in Marshfield.

FINDING

Analyses performed at Duxbury Bay, Plymouth Beach, Warren Cove, and Marshfield demonstrated Cs-137. This is attributed "....to some extent..."[1] to the fission products related to fallout from previous weapons testing. Rocky Point, Manomet Point, Duxbury Bay have had positive values for Co-60 which Boston Edison attributes to operation of PNPS.

E. TERRESTRIAL

Terrestrial samples include milk, cranberries, vegetables, and beef forage or cattle feed.

1. Milk
Milk is collected from the cows at the Plymouth County Farm and Whitman Farm, semi-monthly when the animals are on pasture, otherwise at a monthly interval. Analyses for gamma isotopes, Sr-87, Sr-90, and I-131 are performed.

FINDING

The 1982 Report states that of the isotopes present, i.e., Sr-90, Sr-89, Cs-137, "...PNPS-1 probably contributed much less than 0.01% of the measured concentration..."[1] Most is attributed by Boston Edison to fallout from nuclear weapons testing.

1 Environmental Radiation Monitoring Program, Report No. 17 (1984), p. 3-47.

2. Cranberries
   Cranberries from a Manomet Point Bog (2.6 miles SE), Bartlett Road Bog (2.8 miles SSE/S), and Pine Street Bog (17 miles WNW) are analyzed for gamma isotopes at the time of harvest.

   FINDING

   Cs-137 has been found at the Manomet Point Bog at a level greater than ten times average background for that isotope. A comprehensive study of cesium uptake in cranberries was performed during 1978. This report identified fallout from previous nuclear weapons testing as the primary source of cesium in cranberries.

3. Vegetables
   Vegetable samples are collected at the Karbott Farm and Bridgewater Farm as well as other nearby gardens.

   FINDING

   Co-60 at farms 1.5 miles SSW and 1.0 miles W were attributed to controlled releases from PNPS. In addition, Cs-137 present in the sample at the farm 1.5 miles SSW was attributed to PNPS.

4. Beef Forage
   Beef forage is tested annually from the Plymouth County Farm, Whitman Farm, and Bridgewater Farm.

   FINDING

   No plant related isotopes have been found.

It might be of interest to the reader to note the selected gamma exposure data from the 1982 Report which are found on the following pages. If one compares gamma exposure across each of the quarters at each station listed, one can clearly see some patterns of increased exposure. There are, however, inconsistencies between the distance of some stations from the Plant and the level of reading obtained during a given quarter.

Such inconsistency needs to be addressed by Boston Edison and by the Commonwealth. At the least, there should be an increase in the numbers of TLD's, particularly in areas contiguous to the Plant. Stations should form a tight ring around the plant and rings should be replicated, as far as feasible, in circles of widening radii.

[1] Environmental Radiation Monitoring Program, Report No. 15 (1982), p. 3-69.

GAMMA EXPOSURE (TLD) SELECTED DATA FOR FOUR QUARTERS OF 1982

Station Location (Designation)	Distance and Direction from Reactor	Microrads per Hour Quarter of 1982: First	Second	Third	Fourth	
OFFSITE STATIONS:						
East Weymouth (EW) *	23 miles NW	4.00	8.30	11.84	8.62	above
Kingston (KS)	10 Miles WNW	4.41	6.45	8.14	8.55	avg
Sagamore (CS)	10 miles SSE-S	5.22	ND	6.82	6.50	below
Plymouth Airport (SA)	8 miles WSW	2.68	5.89	15.40	6.87	below
North Plymouth (NP)	5.5 miles WNW	4.59	8.47	14.11	8.21	above
Plymouth Center (PC)	4.5 miles W-WNW	ND	4.60	7.62	6.01	below
South Plymouth (SP)	3 miles WSW	5.91	6.80	12.91	6.61	avg
Manomet (MS)	2.5 miles SSE	4.73	8.28	20.77	9.28	above
Manomet (ME)	2.5 miles SE	6.46	9.33	16.43	ND	above
Manomet (MP)	2.25 miles ESE-S	5.11	7.19	10.91	7.59	above
Cleft Rock Area (CR)	0.9 miles S	7.97	8.89	15.52	8.57	above

high emissions

In general, above avg emissions of gamma rays emitted during third + fourth quarter reads,

* Control Station.

ND No Data due to missing TLD.

Continued

GAMMA EXPOSURE (TLD) SELECTED DATA FOR FOUR QUARTERS OF 1982

Station Location (Designation)	Distance and Direction from Reactor	Microrads per Hour Quarter of 1982: First	Second	Third	Fourth	
ONSITE STATIONS						
Rocky Hill Road (ER)	0.8 miles SE	4.63	6.14	6.91	10.84	below
Microwave Tower (MT)	0.38 miles S	4.06	9.55	13.21	9.44	Avg
Rocky Hill Road (WR)	0.3 miles W-WNW	4.64	11.22	17.15	9.85	above
Rocky Hill Road (B)	0.26 miles SSE	4.02	8.94	8.28	11.15	below
Property Line (H)	0.21 miles SSW	8.11	15.97	11.43	12.89	
Property Line (I)	0.14 miles W	4.34	8.98	10.93	9.31	
Public Park. Area(PA)	0.07 miles N-NNE	5.07	8.73	11.26	7.30	below
Overlook Area (OA)	0.03 miles W	6.95	22.51	30.99	22.97	above
Property Line (PL)	0.34 miles NW	4.38	7.29	11.75	10.31	avg
Ped. Bridge (PB)	0.14 miles N	8.32	17.49	22.81	17.60	avg
East Breakwater (EB)	0.35 miles ESE	4.84	8.18	10.10	7.77	
Warehouse (WS)	0.03 miles SSE	16.38	10.83	26.60	14.03	avg
Geographic Regional Averages:						
Near Plant	0 - 0.16 miles	09.18	14.89	22.92	15.47	
Exclusion Area	0.25 - 0.68 miles	5.54	9.10	11.22	9.56	
Distant Neighborhood	0.7 - 6.5 miles	4.39	8.03	11.74	7.86	
Background	8 - 21 miles	4.08	6.87	10.55	7.63	

* Control Station.

ND No Data due to missing TLD.

PILGRIM NUCLEAR POWER STATION
ENVIRONMENTAL RADIATION MONITORING PROGRAM
Report Number 19
January 1 - December 31, 1986

The following information was excerpted from the above mentioned report when it became available from Boston Edison Company. Only "Findings" are included herein since explanations of data collection locations and methods were described earlier.

RESULTS OF ANALYSES

A. AIR PARTICULATE FILTERS

FINDING

There were no positive measurements of any nuclides characteristic of reactor operations attributable to PNPS-1 observed in the quarterly composite samples. There were positive measurements of nuclides characteristic of reactor operations attributable to the Chernobyl Nuclear Power Plant accident in the second quarter composite samples. These nuclides were: Ru-103, Cs-134 and Cs-137. In addition, high concentrations of Be-7 were also seen.

B. IODINE

FINDING

As a result of the Chernobyl accident, positive indications of 1-131 were detected in the charcoal filters in all stations from week #20 through week #24 (late May to early June) with the highest concentrations seen during week #21.

C. SOIL

FINDING

Soil analyses are performed once every three years for gamma isotopes. See 1982 report.

D. DIRECT RADIATION

1. CONTINUOUS TLD

FINDING

Beyond the "exclusion area" (for this purpose, the 0.25-0.7 mile region), dose rates show no significant plant effects.

2. FIELD SURVEY

FINDING

Survey results are within the expected natural background exposure rates in the northeastern part of the United States.

E. WATERBORNE

FINDING

There were no positive measurements of nuclides characteristic of reactor operation observed at any of the three sampling locations. The only positive measurements observed were due to naturally occurring nuclides (K-40 and AcTh-228).

F. SHELLFISH

FINDING

There have been positive measurements of Be-7, Mn-54, Co-60, AcTh-228 and K-40 in samples from the Discharge Canal. In addition, there have been positive measurements of Be-7, AcTh-228 (peak) and K40 at Warren Cove; AcTh-228 and K-40 at Duxbury Bay; and Be-7, AcTh-228 and K-40 at the control station in Marshfield. There was one positive measurement of Ru-103 at Manomet Point in a sample which was collected on 7/8/86.

The observed concentrations of Mn-54 and Co-60 were the result of PNPS-1 liquid releases. The contribution of Ru-103 was due to Chernobyl-related radioactivity. The observed concentrations of Be-7, AcTh-228 and K-40 are due to the natural occurrence of these nuclides.

G. ALGAE (IRISH MOSS)

FINDING

There have been positive measurements of Be-7, Co-60, Ru-103 and K-40 at the Discharge Canal. In addition, there have been positive measurements of Be-7, Co-60, Ru-103, I-131, AcTh-228 and K-40 at Manomet Point (Station 15-3 miles-SE); and Be-7, Co-60, AcTh-228 and K-40 at the control station at Ellisville (Station 22-8 mi-SSE).

The measured concentrations of Co-60 at the Discharge Canal are certainly due to liquid effluents from PNPS-1. The observed concentrations of Co-60 at Manomet Point and Ellisville were the result of PNPS-1 liquid releases. The highest concentration of Co-60 was seen at the Discharge Canal.

H. LOBSTER

FINDING

The results are unremarkable in that there were no positive measurements of any isotopes other than K-40 in either the indicator or the control samples (K-40 is a naturally occurring nuclide).

I. FISH

FINDING

A striped bass sample collected on 10/2/86 at the Discharge Canal Outfall Area indicated a positive measurement of Cs-137.

J. SEDIMENTS

FINDING

It is clear that positive measurements of Co-60 and Cs-137 were observed. The highest concentration of Co-60 was observed in a sediment sample (24-26 cm) taken from Rocky Point (Station 11) on 5/19/86. In addition, Co-60 was observed in all of the sediment segments (0-30 cm) obtained from Rocky Point on 5/19/86 and in two sediment segments (16-20 cm) from Duxbury Bay collected on 5/29/86. The concentrations of Co-60 at Rocky Point are due to liquid effluents from PNPS-1. The concentration of Cs-137 at the 24-26 cm level from Rocky Point was most likely due to controlled liquid releases from PNPS-1. The measured concentration of Be-7, and to some extent Cs-137, at Duxbury Bay, Plymouth Harbor and Marshfield are attributable to the fission products related to fallout from previous weapons testing.

K. MILK

FINDING

The positive measurements of I-131 in the samples from week #19 through week #27 (late May until early July), and the positive measurements of Cs-134 and Cs-137 from week #21 through week #27 were attributable to Chernobyl-related radioactivity. There was only a small amount of strontium released during the Chernobyl accident which resulted in negligible Sr-89 and Sr-90 in the Chernobyl-related radioactivity.

The highest concentration of Sr-90 occurred at Plymouth County Farm (collected on 9/4/86) and the highest concentration of Sr-89 occurred at the Plymouth County Farm (collected on 6/19/86). However, there were no positive measurements made of either Sr-89 or Sr-90, there were only indications of the presence of Sr-90. It is unlikely that PNPS-1 is the major source of the indicator station activity.

Prior to week #21 and after week #27, the highest concentration of Cs-137 occurred at Plymouth County Farm (3.5 mi-W) in early September (Collected on 9/4/86). Edison claimed that the primary source of Cs-137 was other than PNPS-1, and was most likely due to fallout from previous atmospheric weapons testing.

L. CRANBERRIES

FINDING

The only manmade radionuclide detected was Cs-137, which appeared in the Manomet Point Bog sample (collected on 9/23/86). Claim was again made that the measured concentration was due to fallout from previous weapons testing and a lack of adequate potassium in the soil.

M. VEGETATION

FINDING

The only nuclides observed, other than naturally occurring Be-7, AcTh-228 (peak) and K-40, was Cs-137. A positive measurement of Cs-137 was detected in vegetation collected from two locations on 9/16/86. Because of the absence of Cs-134 Edison again concluded that weapons testing fallout was the primary source of Cs-137.

N. FORAGE

FINDING

The following positive measurements were detected at two stations: Be-7, Ru-103, Cs-134, Cs-137 and K-40. The beef forage samples were both collected on 6/19/86. Edison again concluded that the contribution of Ru-103, Cs-134, and Cs-137 were due to the Chernobyl accident.

In addition to the above data from the 1986 Report, some data from the Radioactive Effluent and Waste Report (January - June 1987) can be found on the following page. These data are of interest in that they demonstrate continued releases of materials into Cape Cod Bay during periods of Plant shut-down. Plant decontamination accounts for increased numbers of batch releases. (The decrease in average stream flow in number 6 was due to the use of one pump rather than three.)

SOURCES OF DATA:

PILGRIM NUCLEAR POWER STATION
ENVIRONMENTAL RADIATION MONITORING PROGRAM
REPORT NUMBER 19
January 1 - December 31, 1986

AND

RADIOACTIVE EFFLUENT AND WASTE DISPOSAL REPORT
January 1 - June 30, 1987

BATCH RELEASES OF RADIOACTIVE MATERIALS IN LIQUID EFFLUENTS INTO CAPE COD BAY

	January to June 1986	July to December 1986	January to June 1987
1. Number of batch releases	143	125	211
2. Total time period for batch releases (Hours)	368.7	216.7	439.7
3. Maximum time period for a batch release (Hours)	8.42	10.4	16.2
4. Average time period for batch releases (Hours)	2.57	1.7	2.0
5. Minimum time period for a batch release (Hours)	0.25	0.08	0.25
6. Average stream flow during periods of release of effluent into a flowing stream (Gallons per Minute)	234,500	155,000	79,200

DEPARTMENT OF PUBLIC HEALTH RADIATION MONITORING PROGRAM

This report is based upon data supplied to Dr. Kathleen Leslie and Ms. Marie Fehlow by Robert M. Hallisey, Director, Radiation Control Program, Massachusetts Department of Public Health (DPH).

The DPH monitors radiation emissions from PNPS via three routes: (1) thermoluminescent dosimeters (TLDs), (2) main stack and reactor building vent monitors, and (3) discharge canal releases recording equipment.

A. TLDs

DPH TLDs have been in place since the third quarter of 1981. They are located at twenty-four sites within a five-mile radius of the plant. TLDs measure gamma radiation and are read quarterly. Some State TLDs are located together with those of Boston Edison and the NRC, some are located separately. According to Mr. Hallisey, monitoring is necessary only within the five-mile radius because, should increases in radiation levels be demonstrated close to the Plant, "doses at further distances can be calculated using the inverse square law."

FINDING

The State has not found any levels of radiation that exceed background at their TLD stations.

B. Stack Emissions

The DPH visits PNPS weekly to inspect the automatic strip chart recorder from the main stack and the reactor building vent for quantitative release rates from each stack of gaseous effluents, particulates, and I-131.

FINDING

Inspection of reports from 1/86 - 10/86 revealed no gaseous releases which exceeded technical specifications.

C. Liquid Releases

The DPH visits PNPS weekly to inspect the recording of liquid releases from PNPS into the ocean.

FINDING

Inspection of reports from 1/86 - 10/86 revealed no releases of liquid effluents which exceeded technical specifications.

GLOSSARY

1) Radiation - Radiation is energy in the form of waves or particles that can penetrate matter. Although the term "radiation" includes such things as light or radio waves, it is most often used to mean "ionizing" radiation, which can produce charged particles ("ions") in materials it strikes.

2) Ionizing radiation - Has the ability to knock electrons out of atoms, creating electrically charged ions. These ionized atoms have the ability to damage living tissue. Examples: x-rays, gamma rays, alpha particles.

3) Nonionizing radiation - Does not have the above property. Examples: microwaves, sound waves, light.

4) Radioactivity - Results from the release of radiation from the nucleus of an atom with an unstable ratio of protons to neutrons in order to achieve stability.

5) Particulates - Microscopic particles that may be radioactive.

6) Noble gas - A gas that is chemically and biologically nonreactive, e.g., xenon and krypton.

7) Alpha radiation - Consists of positively charged particles. Alpha radiation will be stopped by the outer layer of skin; it can be stopped completely by a sheet of paper. However, the potential hazard from alpha emitting materials is due to the possibility of internal deposition to the body by ingestion or inhalation.

8) Beta radiation - Beta particles are similar to electrons, but originate in the nucleus of the atom. Beta is more penetrating than alpha radiation and can pass through 0.5-1 centimeter of water or human flesh. A sheet of aluminum a few millimeters thick can stop beta radiation. There is also an inhalation hazard from beta radiation.

9) Gamma radiation - Consists of photons (wave energy) that can be very penetrating. Depending on the energy levels, gamma radiation can pass through the body. Dense materials such as concrete and lead are used for shielding against gamma radiation.

10) Effluent (radiological) - Release of radionuclides originating from the reactor vessel into the environment.

11) Manmade radiation - Radiation from medical and dental use of X-rays and radioactive materials to diagnose and treat disease, giving an average dose of 90 mr/year/person. Another 10 mr/year/person are received from fallout from nuclear weapons testing, nuclear power plants, industrial uses of radioactive materials and minute emissions from certain consumer products such as color television sets.

Continued

GLOSSARY (Continued)

12) Natural background radiation - Radiation from natural sources such as cosmic rays, granite, natural gas; an average of 100 millirems/year/person.

13) Rad - Radiation absorbed dose or amount of energy deposited in living tissue by ionizing radiation.

14) Rem - A unit for measuring the biological effects on a person from a dose of radiation. A rem of exposure produces a constant biologic effect regardless of the type of radiation.

15) Millirem - 1/1000 of a rem.

The CHAIRMAN. Thank you, Dr. Healy. I think we'll hear more about some of these issues when we hear from some of our State officials and the relationship between their authority and the power of the Federal Regulatory Commission, and I look forward to that.

Let me ask you, Dr. Healy. You're familiar with Dr. Cobbs' report about the increased leukemia rates that he discovered?

Dr. HEALY. Yes.

The CHAIRMAN. And we'll make that report a part of the record. Rather than my reading through that, perhaps you could briefly describe the conclusions.

Dr. HEALY. Well, what Dr. Cobbs did is he made note of the highly unusual incidents of leukemia in a five-town range, which includes: Plymouth, Kingston, Duxbury, Marshfield, and Scituate and what he attempted to do was to connect this incident with radioactive emissions from the plant.

What he—my understanding is what he hypothesized was that the topography, the coastal wind circulation and the coastal fogs formed a natural barrier, which would hold and entrap radioactive residues from Pilgrim I.

Our committee is aware that there is some disagreement with the topography-wind hypothesis, but we are checking into it with our experts, but quite frankly, Mr. Chairman, our committee is not so much interested in such theories. We are far more interested in the data that we can get from the field, and those data, and only those data, we feel from the monitoring, are going to allow us to get to any causal inferences, and we strongly recommend——

The CHAIRMAN. Now, the State has looked into this as well, has it not?

Dr. HEALY. The State has used data from—my understanding is that the State has analyzed and reanalyzed data from the Cancer Registry, but those data our committee feels are flawed in that the procedures and the methodology are flawed. It is my understanding that they are moving toward a comprehensive study at this time, but our committee will be recommending that we go far beyond the State to the national level.

The CHAIRMAN. I think the suggestions which you make, and which Mary Ott and others have made with regard to health studies are excellent suggestions, as we have heard in your testimony, and read about in preparation for the hearing, and also in some of the communications that we have received from many of you and from others. It seems that the kind of pattern that we have heard here is very similar to the type of pattern that we heard about in connection with Three Mile Island in 1979 when this committee held hearings on the health implications of that particular difficulty.

So I have written a letter to the National Institutes of Health, to Dr. Wyngaarden, who is the Director of the NIH, and asked him to do a health study. My request for investigation refers to, and I quote, "reports of excessive leukemia in certain Massachusetts towns downwind from the Pilgrim I power plant in Plymouth"; and I have specifically asked him to have his people determine whether there is a causal connection. I have also told him the he might

want to take a look at the problems at Three Mile Island as well. I have sent that out today.

I will be in touch personally with Dr. Wyngaarden, and as soon as I get some results or some response, I will share it with you and other members of the community.

[The information referred to follows:]

United States Senate

COMMITTEE ON LABOR AND
HUMAN RESOURCES

WASHINGTON, DC 20510-6300

January 7, 1987

Dr. James B. Wyngaarden, Director
National Institutes of Health
14 North Drive
Bethesda, Maryland 20814

Dear Dr. Wyngaarden:

Over the past year, a number of individuals and groups have urged the Committee to hold hearings on the subject of adverse health effects of radiation exposure. They are obviously concerned about those dangers in the context of potential nuclear power plant accidents. They are also concerned about those dangers as a result of the possibility of low-level radiation emanating from such plants. And, of course, considerable alarm has been expressed with respect to this subject as it relates to the accident which occurred at the Three Mile Island (TMI) plant.

It has been my view that hearings may be appropriate at such time as there are adequate data available, and when appropriate scientific inquiries have been conducted. At that time, a comprehensive public airing of the relevant information, and consideration of proposals for remedial action could be useful and productive.

In view of the number of incidents and situations which have prompted legitimate concern, and because of the dearth of data relating to this subject, it would be helpful for the National Institutes of Health (NIH) to conduct an appropriate inquiry into this entire question. I would urge that such an undertaking address the question of whether the TMI accident has been a causal factor in what has been described as "observed excesses of cancer." In addition, because there have been similar reports of excesses of leukemia in certain Massachusetts towns "downwind" from the Pilgrim I power plant in Plymouth, Massachusetts, it would be helpful to have your assessment of that situation as well.

I am sure you are familiar with the studies which have already been carried out with respect to increased cancer rates near nuclear test sites in Nevada. Other studies have focused upon radiation exposure in Colorado and Utah. Those studies, which have been sponsored by the Department of Energy, the National Academy of Sciences, and state and local health

Dr. James B. Wyngaarden
Page 2

departments, have suggested a possible association between the test sites and the higher incidence of cancer. Accordingly, it would be appropriate for the NIH, as the foremost biomedical research center in the world, to address the question of whether a causal connection does or does not exist. And I would suggest that such an undertaking use as its first "models" for evaluation the TMI and Pilgrim I cases which I have described.

You know of my continued confidence in the high quality work of NIH. I look forward to learning the results of your examination of this critical health issue.

Sincerely,

Edward M. Kennedy
Chairman

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institutes of Health
National Cancer Institute
Bethesda, Maryland 20892

JAN 2 [illegible]

The Honorable Edward M. Kennedy
United States Senate
Washington, D.C. 20510

Dear Senator Kennedy:

I am pleased to respond to your letter of January 7, 1988 regarding potential health risks associated with low-level radiation. Specifically, you raised concerns about the health consequences of nuclear power plant accidents, adverse effects related to nuclear power plant operations, and cancer risks linked to radioactive fallout from nuclear weapons testing.

The National Institutes of Health is actively involved in studying the adverse effects of ionizing radiation, and we concur with your view that the risks at low levels need further clarification. We know, of course, that radiation can cause cancer, but the biological effects of quite low levels are a subject of current scientific conjecture. Because new information relevant to the assessment of low-level risks will be available within the next one or two years, we do not believe public discussions at this time would be as fruitful as they might be in the future. Our reasoning is discussed below.

The descriptive studies of leukemia clusters around the Pilgrim power plant in Massachusetts, and several plants in the United Kingdom, have led us to initiate a large-scale evaluation of cancer deaths occurring among persons living near the over 100 reactors operating in the United States. We are correlating county mortality data from the 1950s through early 1980s with reactor operations to determine whether the previous reports might be chance occurrences based on small numbers, or whether there might be valid reasons for concern. This evaluation should be completed within about one year.

One of the major radioactive isotopes emitted during nuclear power plant operations, and from nuclear weapons testing, is iodine-131. For the past three years we have been collaborating with Swedish colleagues on a study of 40,000 patients given low doses of iodine-131 for diagnostic reasons. This large study will be finished within one year and will prove invaluable in estimating the possible adverse effects from this environmental contaminant. We have also evaluated descriptive mortality data regarding possible cancer risks in the general population living downwind of the Nevada nuclear test site. While many reported associations are unsupported by these data, a small increase in leukemia in southwest Utah cannot be ruled out at this time. Our contract-supported study with the University of Utah should provide more definitive answers within the next year. Finally, staff members have conducted studies of the military personnel participating at nuclear weapons tests, and have confirmed that leukemia was increased above expectation, but apparently only for participants at one test series. No excess mortality from other malignancies was found among participants at any test series.

Page 2 - The Honorable Edward M. Kennedy

The most serious health impact of the Three Mile Island (TMI) accident that can be identified with certainty is mental stress to those living near the plant, particularly pregnant women and families with teenagers and young children. Although increased risks of cancer, birth defects and genetic abnormalities are potential long-term consequences of low-level irradiation, few if any such effects are likely. The average dose of radiation to the 36,000 people living within a five-mile radius of the plant was only 2-8 mrem, or approximately what might be received from natural background radiation within one or two weeks. There is no serious possibility that this dosage would result in any deleterious effects that could be detected epidemiologically. (In contrast, at Chernobyl in the USSR the average dose to the 24,000 people living near the reactor was estimated as 44,000 mrem.) The Pennsylvania Department of Public Health, in consultation with the Centers for Disease Control, however, is conducting periodic health and behavior surveys of the population living near TMI. Although psychological effects are temporary in most individuals, the ultimate impact of these effects remains to be fully assessed, as does the degree to which they may differ from those caused by other accidents or disasters. The mental stress following TMI, of course, has been aggravated by the fear that a larger release of radiation might take place, with consequences that could be disastrous as now exemplified by the Chernobyl accident. While we are thankful that such an event has not occurred in the United States, we should profit from these experiences by taking steps to minimize the risks of such accidents in the future.

Finally, within two years the National Academy of Sciences and the United Nations will complete their next reports on the biological effects of low-level radiation. We are also awaiting the publication of these scientific documents before embarking upon our next revision of the Radioepidemiological Tables mandated by Congress.

It is important to stress that useful information about very small health effects, like those associated with very low levels of radiation, is extremely difficult and expensive to obtain. An indirect approach, such as studying populations with higher-level exposures and extrapolating the results to lower levels, tends to be far more productive. For example, studies of the workers at nuclear power plants would be particularly informative because the doses, though low, would be higher than to the general population, and cumulative doses could reach levels where radiation effects might be detectable. By law, radiation doses are recorded on individual workers, and we have contacted the Nuclear Regulatory Commission about the value of creating a registry of the almost 100,000 workers they monitor each year in the United States. Your encouragement and support for the development of such a registry would be invaluable and greatly appreciated.

In closing, I appreciate your continued support for our medical research program, and I will keep you informed on developments in the area of radiation studies as results from our investigations become available.

Sincerely,

James B. Wyngaarden

James B. Wyngaarden, M.D.
Director

I think the National Institutes of Health probably has as good a capability and capacity to do that as any in the country. Hopefully, they will coordinate their work with the State officials and local officials as well.

I would hope that they would be able to call on much of the expertise that we have heard this evening and other expertise as well in their consideration.

Let me ask, because we want to move on, Mr. Abbott, about one suggestion that has been made which is whether we ought to have, create independent of the NRC, an independent body to oversee the public health aspects of nuclear plant radiation releases. I don't know if you have any opinions about that. I don't know quite how we would set it up.

Mr. ABBOTT. Well, Mr. Chairman, there is a definite perception of the public that the NRC is still promoting nuclear power, rather then being most concerned about the health and effect of nuclear power.

I think part of what I was trying to express was that the perception of the public was that really nothing was being done to protect it, and I don't think we have any comfort level that the NRC is doing it. Whether—I have pleadings to the State of Massachusetts to have another Federal agency which is to be kept totally independent of the promotion of nuclear power; then that might do the job.

The CHAIRMAN. I noted your testimony, Mary Ott, with regards to the difficulties that you had in getting information, having to run through the Freedom of Information Act to get that, that is obviously enormously discouraging. I don't know whether you have any reaction to some independent health advisory group to monitor these types of activities.

Of course, we would have to decide who appoints it; who it is accountable to, and whether we are just creating more bureaucracy, but maybe you can give some thought to it. We might try to circulate some suggestions along those lines and try to get some of your reaction to them.

And, Anne, I'm still troubled by your report in terms of how any evacuation plan is going to have to deal with some of those who have physical or mental limitations. You, as I understand, have made those representations to FEMA, have you?

Ms. WAITKUS-ARNOLD. FEMA, yes.

The CHAIRMAN. And I understand that one of the major conclusions FEMA reached when they withdrew their approval was that the evacuation plan contained inadequate planning for the evacuation of the special needs population.

Ms. WAITKUS-ARNOLD. Right.

The CHAIRMAN. And I think you should take some sense of satisfaction that someone at least listened to what, I think, is really one of the most provocative, unbelievable things that I've heard in preparing for the hearing. I must say I was absolutely dumbfounded. I should probably have known about it, but I think it must have stirred the heart and soul of any citizen to think that that's the way we're going to treat our fellow citizens, particularly those who are facing some physical challenge.

I want to thank all of you very much. You have been extremely helpful. I think the questions that you have raised have enormous potential impact for the people living in the area and throughout the state. We're very grateful to all of you for your hard work. It is quite clear from your testimony and from your fuller statements the amount of time and the expertise that you have put into this consideration, not only yourselves, but with your fellow citizens. It is really citizenship at its very best.

I'm grateful to you, and I will take the liberty, when I talk to Dr. Wyngaarden, to mention each of you, and to send along your testimonies, and, hopefully, NIH will have your input when they do their work. I want to thank all of you for your presentations. Thank you very much.

[Applause.]

The CHAIRMAN. Our next panel is comprised of some representatives and public officials who represent people who live in this area, and also the representative of one of our foremost public interest organizations. All of these witnesses have worked long and hard on Pilgrim I questions. I welcome them here this evening to share with the committee their judgments and concerns.

First, we have Senator Bill Golden, who I'm sure is no stranger to any of you nor to me. Bill has been unrelenting in his attention to Pilgrim and I look forward to his testimony.

We'll also hear from State Representative Larry Alexander, who has previously testified before Congress on Pilgrim. Peter Forman, State Representative from Plymouth, who led a state legislative committee effort on the subject of Pilgrim; David Malaguti, who is the chairman of the Plymouth Board of Selectmen, and who has devoted a lot of time on the issue; and Ms. Rachel Shimshak, from the Massachusetts Public Interest Research Group, an organization which over the last several years has issued three major reports dealing with the Pilgrim I plant.

I welcome all of you here and look forward to your presentations. Why don't we go left to right. Three minutes each.

STATEMENTS OF LAWRENCE ALEXANDER, STATE REPRESENTATIVE; PETER FORMAN, STATE REPRESENTATIVE; DAVID MALAGUTI, CHAIRMAN OF THE PLYMOUTH BOARD OF SELECTMEN; AND RACHEL SHIMSHAK, MASSACHUSETTS PUBLIC INTEREST RESEARCH GROUP

Mr. ALEXANDER. Thank you, Senator. I also would like to thank you for this opportunity, and I have some additional materials which I would like to offer to your committee, as an appendix, along with copies of my testimony.

As chairman—house chairman of the Massachusetts Legislature's Joint Committee on Energy——

The CHAIRMAN. Wait a second. I forgot to swear you in.

[Applause.]

[Witnesses sworn.]

Mr. ALEXANDER. Well, if that's the case, let me change my speech. [Laughter.]

Just kidding.

Senator, I testify today with great appreciation for your concern about this very important subject. I'm State Representative Larry Alexander. I'm house chairman of the Legislature's Joint Committee on Energy, and I believe that there are two significant issues associated with nuclear power that warrant major Federal investigations immediately.

First, Congress should order an in-depth, nationwide analysis of whether people suffer adverse health consequences as a result of living near nuclear powerplants. I was delighted to hear about your request to the National Institute of Health in that regard.

Second, I believe that Congress should order an intense investigation of the safety systems that operators of European nuclear reactors have added to their nuclear powerplants to determine whether operators of American nuclear powerplants should make similar modifications.

Let me discuss each of these two issues in a little more detail. First of all, with respect to the health effects of living near nuclear reactors, there is an increasing body of scientific evidence that seems to suggest that routine and accidental releases of radiation from nuclear reactors may be causing increased leukemia, cancer, infant mortality, congenital defects and other adverse consequences.

For that reason, I filed a bill to have Massachusetts set its own standards for radioactive emissions from nuclear powerplants, which it is allowed to do under federal law. I'm pleased to say the bill passed the House, but it has failed to pass the Senate yet, but I hope that ultimately, we'll be able to pass that law.

The Massachusetts Department of Public Health has found statistically significant increased incidences of leukemia in communities near the Pilgrim reactor. There was a 59-percent increase in blood disorders, including leukemia, for Plymouth, Kingston, Duxbury, Marshfield, and Scituate for the years 1982 through 1984. In 1985, there were three times as many cases of these blood disorders than would normally be expected for women in Plymouth—six cases instead of two—and the total increase for the five towns from 1982 through 1985 was a statistically significant 43 percent.

Dr. Sidney Cobb, whom you alluded to earlier, found that there seemed to be an increase in infant mortality and congenital defect rates that took place in coastal communities adjacent to or north of Plymouth soon after significant radioactive emissions were discharged from Pilgrim in the 1970's.

There also seems to be some evidence of perhaps increased leukemia for people living downwind from Maine and Connecticut reactors. And there was a recent study in Lancet magazine suggesting a possible correlation between proximity to nuclear power plants and increased leukemia incidences in England.

Therefore, I hope that Congress will do a major analysis of this issue on a nationwide basis to put this issue to rest one way or the other for citizens who live near those nuclear powerplants.

Let me turn now briefly to the issue of nuclear reactor safety, particularly with reference to the General Electric Mark I reactor found at Pilgrim. I have serious doubts about the adequacy of the containment structure at Pilgrim.

Many European reactors have safety features that American reactors don't have. Some, for instance, have a filtered vent to prevent overpressurization and a consequent breach of containment. The filters trap most of the radiation.

My understanding is that Boston Edison does not plan to put any filters in the vents that it is going to put in at the Pilgrim plant. I find that strange. Even the owners of the Shoreham reactor in Long Island have announced their intention to install a filtered vent, and I fail to see why the Pilgrim owners do not plan to do so as well.

Many European reactors also have an additional, independent decay heat removal system that serves as a type of backup cooling system in case of failure of the original residual heat or emergency core cooling system. Some of the European systems have done that, and yet Boston Edison has not seen fit to install this system here. If it's good enough for some of the European plants, I wonder why it is not good enough to have here.

A federal investigation, preferably independent of the NRC, should be undertaken immediately of the filtered vent, the bunkered RHR system, and other European safety systems to determine whether they should be added to American nuclear powerplants.

Congress should also consider requiring construction of a second steel-reinforced concrete containment structure and molten core barriers before General Electric Mark I-designed plants, such as Pilgrim, are allowed to continue to operate. Pilgrim should also not be allowed to restart unless the Governor reaches a threshold determination that an evacuation plan can adequately protect public health and safety, and local officials and the Governor have approved such a plan.

Let me add one final word with regard to Pilgrim. I am becoming more and more convinced that we may not need the power from Pilgrim.

Boston Edison's own forecast of electric supply and demand shows that it probably won't need Pilgrim power from 1990 to the year 2000. With conservation and energy produced by small-power facilities, we may not need electricity from Pilgrim.

So, therefore, all of us should ask ourselves why we should take a risk that we don't have to take. All of us should ask ourselves the ultimate question, do we really need to take the risk of Pilgrim reopening when we may not even need the power it might produce?

[Applause.]

Thank you very much.

[The prepared statement of Mr. Alexander follows:]

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TESTIMONY OF STATE REPRESENTATIVE LAWRENCE R. ALEXANDER,

HOUSE CHAIRMAN OF THE MASSACHUSETTS LEGISLATURE'S JOINT COMMITTEE ON ENERGY,

BEFORE THE LABOR AND HUMAN RESOURCES COMMITTEE OF THE UNITED STATES SENATE

JANUARY 7, 1988

I would like to thank you, Mr. Chairman, and the members of this committee, for your deep concern over this issue and for holding this important hearing here in Massachusetts so that you can hear directly from the citizens who are most affected by the Pilgrim nuclear power plant.

As House Chairman of the Joint Committee on Energy of the Massachusetts Legislature, I believe there are two significant issues associated with nuclear power that warrant major federal investigations immediately.

First, Congress should order an in-depth nationwide analysis of whether people suffer adverse health consequences as a result of living near nuclear power plants.

Second, Congress should order an intense investigation of the safety systems that operators of European nuclear reactors have added to their nuclear power plants, to determine whether operators of American nuclear power plants should make similar modifications.

Let me discuss each of these matters in more detail.

With respect to the health effects of living near nuclear reactors, there is an increasing body of scientific evidence that seems to suggest that routine

and accidental releases of radiation from nuclear reactors may be causing increased leukemia, cancer, infant mortality, congenital defects and other adverse consequences.

The Massachusetts Department of Public Health has found a statistically significant increased incidence of leukemias in communities near the Pilgrim reactor.[1] There was a 59 percent increase in blood disorders including leukemias for Plymouth, Kingston, Duxbury, Marshfield and Scituate for the years 1982 through 1984. In 1985, there were three times as many cases of these blood disorders than would normally be expected for women in Plymouth (6 cases instead of 2), and the total increase for the five towns from 1982 through 1985 was a statistically significant 43 percent.

Dr. Sidney Cobb, the distinguished epidemiologist who originally identified this increase in leukemias, has also found that an increase in infant mortality and congenital defect rates took place in coastal communities adjacent to or north of Plymouth soon after significant radioactive emissions were discharged from Pilgrim in the 1970's.[2] Evidence also seems to suggest some increased leukemias for people living downwind from Maine and Connecticut reactors.[3] Dr. Bailus Walker, President of the American Public Health Association, and a former Massachusetts Commissioner of Public Health, has recommended a regional analysis of the health consequences of living near nuclear reactors.

Dr. Jay Gould recently released a national study revealing higher infant and fetal mortality rates in counties close to boiling water reactors.[4] He believes that emissions from nuclear reactors are associated with nearly 9,000 excess deaths each year.[5]

The United States is not the only country in which studies show possible adverse health consequences for people living near nuclear power plants. A 1987 study in Lancet magazine suggests a significant correlation between proximity to nuclear power plants and increased leukemia incidence in England.[6]

Other studies also suggest a need for further investigation.[7]

While it is very difficult to prove a definite causal link between the 50 million curies of radioactive emissions released from American nuclear reactors and the specific adverse health effects that people have suffered, the growing body of epidemiological evidence suggesting the possibility of such a link makes it imperative that we explore this issue in more detail. The only way to do this thoroughly is for Congress to order a comprehensive nationwide epidemiological study of this matter immediately.

Let me now turn to the issue of nuclear reactor safety, particularly with reference to the General Electric Mark I reactor found at Pilgrim. I have serious doubts about the adequacy of the containment structure at Pilgrim.

Former NRC Commissioner James Asselstine has stated, "America can expect to see a core meltdown accident within the next 20 years, and it is possible that such an accident could result in off-site releases of radiation which are as large as, or larger than, the releases estimated to have occurred at Chernobyl."[8] American reactors, he notes, "were not designed to withstand large-scale core meltdowns."[9]

Many European reactors, on the other hand, have safety features that American reactors do not have. Some, for instance, have a filtered vent to prevent overpressurization and a consequent breach of containment.[10] Their filters trap most of the radiation. The owners of the Shoreham reactor in Long Island have announced their intention to install such a filtered vent. Pilgrim should not restart until and unless Pilgrim has such a filtered vent.

Many European reactors have an additional, independent decay heat removal system that serves as a back-up cooling system in case of failure of the original residual heat removal (RHR) system and of the emergency core cooling system. This back-up system is also independently powered in case of station blackout and is "bunkered" underground to protect against earthquake damage and sabotage.

Swiss authorities have started retrofitting some Swiss reactors with this system, including an older boiling water reactor.[11]

The Pilgrim reactor was shut down in 1986 due to failures of the RHR system. It does not have a back-up, bunkered RHR system. If Europeans are installing additional cooling systems in their boiling water reactors, why shouldn't Boston Edison install the same system to provide more protection against meltdowns at the Pilgrim reactor? Boston Edison should install a bunkered RHR system at Pilgrim before restart.

A federal investigation--preferably independent of the NRC--should be undertaken immediately of the filtered vent, the bunkered RHR system, and other European safety systems to determine whether they should be added to American nuclear power plants. Congress should also consider requiring construction of a second steel-reinforced concrete containment structure and molten core barriers before General Electric Mark I-designed plants such as Pilgrim are allowed to continue to operate. Pilgrim should also not be allowed to re-start unless the Governor reaches a threshold determination that an evacuation plan can adequately protect public health and safety, and local officials and the Governor have approved such a plan.

Let me add one final word with regard to Pilgrim. I am becoming more and more convinced that we may not need the power from Pilgrim. Boston Edison's own forecast of electric supply and demand shows that it probably won't need Pilgrim power from 1990 to 2000.[12] With conservation and energy produced by small-power facilities, we may not need electricity from Pilgrim.

All of us should ask ourselves why we should take a risk that we don't have to take. All of us should ask ourselves the ultimate question--do we really need to take the risk of Pilgrim re-opening when we may not even need the power it might produce?

Thank you very much.

FOOTNOTES

1. "Health Surveillance of the Plymouth Area," Mass. Department of Public Health, March 16, 1987. (Appendix A)

2. "Testimony of Sidney Cobb, M.D.," presented to the Joint Committee on Energy, March 24, 1987. (Appendix B)

3. Ibid.

4. "Nuclear Emissions Take Their Toll;" Gould, J.M. et al; Council on Economic Priorities Publication N86-12; December, 1986, p. 7. (Appendix C)

5. Ibid., p. 9.

6. "Cancer Near Nuclear Installation," Beral, V., Lancet, March 7, 1987, p. 556. (Appendix D)

7. Bibliography of over 100 relevant research papers. (Appendix E)

8. "Testimony of Commissioner James K. Asselstine, U.S. N.R.C., before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce," May 22, 1986, p. 3. (Appendix F)

9. Ibid.

10. "International Nuclear Reactor Hazard Study," Anderson, R. et al, Volume II, September, 1986;
"Europeans Head Toward Filtered Vented Containments after Chernobyl," Nucleonics Week, June 12, 1986.

11. "Muehleberg Begins Backfit for Bunkered Emergency Cooling System," Nucleonics Week, November 13, 1986. Telephone conversations between staff of Commissioner Asselstine, November, 1986, and staff of Joint Committee on Energy.

12. "Conservation and Load Management," Boston Edison, Exhibit V-1 ("Boston Edison's Long Range Resource Plan:" Between 1990-2000, Boston Edison will have more than 500 MW of capacity beyond its reserve capacity needs--Boston Edison receives less than 500 MW of capacity from Pilgrim), submitted to the Department of Public Utilities in November, 1987. (Appendix G)

The CHAIRMAN. Provocative. [Laughter.]

Representative Forman.

Mr. FORMAN. Thank you, Senator. My name is Peter Forman. I'm the State representative for Plymouth and Kingston; I'm a resident of Plymouth. I recently served as house chairman of the legislature's Joint Special Committee to investigate the plant.

I want to congratulate you for this hearing. While many state and local officials have been quite vocal and active trying to keep pressure on the NRC, it is obvious that there is little state or local jurisdiction over nuclear plants, and is almost exclusively under Federal control. As such, we are very pleased that you have taken this initiative.

I understood from your staff that the focus of the hearing was not so much on Edison's performance, rather the performance of the federal agency, particularly the NRC, who regulates the utilities. So I would like to offer a few broad observations about the NRC's work.

One of the most commonly heard criticisms is that the NRC is too much an advocate to nuclear power and not a watchdog. I would like to give you two examples of how I think some of the NRC's thinking is oriented to keeping the plants open.

The first is the lack of decommissioning plans. In the many meetings held, we have come away with a sense that one reason NRC is reluctant to close any plant is because nobody seems to know what to do with the plant once it is closed. That sort of perpetuates an interest in making sure that they are open so those very tough questions don't have to be addressed immediately.

I would urge, as a previous witness has, that Congress and the Administration not allow any delay in selecting a Federal disposal site because I think that's one of the reasons we don't want to address the issue of decommissioning.

In the meantime, though, I think everyone would be well served with decommissioning plans for power plants, including Pilgrim, and I would like to urge the NRC and Boston Edison, along with any State, Federal, and local officials to begin planning for decommissioning, so area residents and ratepayers and State officials will know what's in store for us when a plant is permanently closed.

The second example of NRC gravitation toward keeping plants open is their grading system of plants' performance. We're all familiar with the SALP reports and their three performance ratings. None of these rating categories include failures or fail rates. There are no objective criteria or performance ratings that would trigger a license revocation or a review of licensee performance. I think that the public and nuclear industry need to see clear standards as to exactly what constitutes a poorly run or a failing plant.

The issues surrounding public health are, of course, paramount, but I get the sense that the NRC works in short-term, incident specific reviews of whether or not a plant is responsible for any threat to public health. I would urge the Congress, or an agency other than the NRC, begin some sort of comprehensive, long-term studies to the public health impact, if any, around nuclear powerplants. These studies should include the exposure to health histories, as well as the cumulative exposure to the general public.

I would like to make another general observation about work place safety not related to radiation exposure. Not too long ago, Edison had a project to remove asbestos from the plant. One of the plant employees suggested to me that the work was poorly done and that there was unnecessary risks of asbestos exposure to the employees in the area. Questions were raised about as OSHA's ability to supervise or investigate this problem. And I think some work needs to be done to insure that the NRC regulations and the industry standard to reduce radiation exposure, as well as NRC's almost exclusive jurisdiction over nuclear plants, does not reduce nonradiation related workplace safety standards.

On another matter, questions have been raised about the relationship with contract workers in the plant; who do they answer to, what kind of quality control is achieved and how well do they work with other employees, and understand the NRC regulations. I would hope that the NRC will conduct some sort of fuller investigation into those questions.

As house chairman of the Joint Special Legislative Committee dealing with Pilgrim, there were two matters that we simply were not able to resolve. One was the issue of Mark I designs. Is there, in fact, an increase of containment failure in a Mark I design? Do these higher risks, if any, compensate for some other measures?

The other is over charges of past releases. And Mr. Abbott, I think, has probably done the best job in documenting one such release in 1982.

Should the NRC refuse an adjudicatory hearing on Pilgrim's license, then, at least I hope the NRC, or your committee, would have some sort of hearings on these two issues because these are of critical concern to the area residents, and we simply do not have the resource in our State legislature to begin sorting out the issues of past releases or the Mark I containment issue.

Finally, I would like to very quickly touch on the issue of emergency preparedness. The NRC has created what, I think, is a real jurisdictional mess over the issue of emergency preparedness. By requiring local approval of plans, the NRC may or may not have given States the power to close plants. How far this power actually goes is unclear, but I think it is in everyone's interest that it needs to be clarified, clarified preferably by Congress, not the NRC. This should be done as soon as possible, so that state officials will have some sense as to how much power, if any, state and local officials have in closing a plant and preventing a plant like Pilgrim from coming back on line or preventing one from opening up through the use of the emergency preparedness plans.

Again, Senator, let me congratulate you for focusing some congressional attention on this, and particularly on the NRC and its role as a federal regulator.

[The prepared statement of Mr. Forman follows:]

TESTIMONY OFFERED BY

STATE REPRESENTATIVE PETER FORMAN

BEFORE THE SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES

JANUARY 6, 1988

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Pilgrim Nuclear Power Plant

MARGARET GARDNER
LEGISLATIVE ASSISTANT

Senator Kennedy:

My name is Peter Forman. I am the State Representative for Plymouth and Kingston and a resident of Plymouth. Recently, I served as House Chairman of the Legislature's Joint Special Committee to Investigate the Pilgrim Nuclear Power Plant.

Let me congratulate you for this hearing. While state and local officials have been quite vocal and active in keeping pressure on Edison and the NRC, it is obvious that there is little state or local jurisdiction over nuclear plants. This is a matter of almost exclusive federal control and as such we are pleased to see Congressional attention being focused on this issue.

I understand from your staff that the intent of this hearing is not so much to review Pilgrim's history or to investigate the work Pilgrim has been doing. Rather, it is to review the performance of the federal agencies, specifically the NRC, in regulating Pilgrim.

One of the most commonly heard criticisms is that the

enough of a watchdog. Let me give you two examples of how NRC thinking is oriented to keeping plants open. One is the lack of de-commissioning plans.

From the many meetings held on Pilgrim, I have come away with a sense that one reason NRC is reluctant to close plants is because nobody seems to know what to do with a plant once it has been closed. Clearly, part of the problem is the lack of a permanent disposal or storage site for the high-level waste. This issue needs to be addressed and I hope that neither the Congress nor adminisitration will allow any further delays on selecting a federal site.

In the meantime, though, everyone would be well served to have decommissioning plans for power plants. I would like to urge the NRC and Boston Edison, along with state and local officials, to begin planning for decommissioning. Area residents should know what will be done with a permanently closed site. Likewise, the state and utility ratepayers should know the expected cost of decommissioning.

The second example is of NRC grading of plant performance. As we have seen in the SALP reports, there are three performance ratings. None of the three is a failing grade. There are no objective criteria on performance that would trigger a license revocation or hearing to review licensee performance. The public and nuclear industry need to see clearer standards as to what constitutes a poorly run or failing plant.

The issues surrounding public health are, of course, the greatest concern. However, the NRC seems to work in short-term, incident-specific reviews of whether or not a plant is responsible for a threat to public health.

The Congress, through an agency other than NRC, should begin comprehensive, long-term studies of the public health impacts, if any, of nuclear power plants. These studies should include employee exposure and health histories, as well as cummulative exposure risks to the general public.

As you know, there has been an above-average occurence of certain cancers in the South Shore area. The State Department of Public Health is conducting a long overdue study.

Frankly, I doubt there will be any definite conclusion as to the possible causes of this slight elevation - if in fact there is a cause. However, it would have been useful to have had long-term studies around other plants to see if there were common events, or what the history has been around other plants.

Let me make another observation about general workplace safety. Not too long ago, Edison had a project to remove asbestos from the plant. An employee has suggested to me that the work was poorly done and there were unnecessary

risks of asbestos exposure. Questions were raised about OSHA's ability to supervise and investigate this work. I think some work needs to be done to ensure that NCR regulations, the strict standards to reduce radiation exposure, and NRC's almost exclusive jurisdiction over nuclear plants does not reduce non-radiation work place safety standards.

On another matter, questions have been raised about the relationship of contract workers in a plant. Who do they answer to? What kind of quality control is achieved? How well do contract workers work with regular employees? How well do contract workers understand and follow NRC regualtions? These are matters which I have not seen fully studied.

There were two important matters in the Special Committee's work which we simply were unable to resolve. One was the issue of Mark I designs. Are there serious flaws? Can they be compensated by other measures? Is there an increased risk of containment failure in a Mark I?

The second was an overcharge about part releases. The best documented charge is over the 1982 release already discussed by Mr. Abbott. We did not have the expertise or resources to determine what was released and over how large an area.

Should the NRC refuse an adjudicutory hearing on Pilgrim license then there should at least be NRC or Congressional hearings on these two issues.

Finally, I would like to touch on the issue of Emergency Prepardness. The NRC has created a real jurisdictional mess over this issue. By requiring local approval of plans the NRC may or may not have given states the power to close plants. How far this power actually goes is unclear but it should be clarified preferably by Congress and as soon as possible.

Senator, again let me congratulate you for focusing some Congressional attention on the role of the NCR and their performance.

The CHAIRMAN. Thank you very much. Senator Golden.

Mr. GOLDEN. Mr. Chairman, I want to thank you first for your continuing and long standing interest in this issue, and particularly for responding to the request of local officials to bring this hearing to us this evening. I particularly thank you for the opportunity to testify before you this evening.

I believe that the Pilgrim nuclear power station should be closed for reasons of safety, reliability and economics. There is overwhelming evidence that you will hear tonight that it is one of the worse managed nuclear powerplants in the country. Its containment vessel has been proven to be defective, no emergency plans exist to adequately protect the public in the event of a serious accident at the plant. Evidence has also been mounting of serious security and radiological control problems at the plant, and a recent study has demonstrated that it would be less expensive to shut Pilgrim down than it would be to allow it to start up again; yet no level of government has acted decisively to shut this plant down.

Under the Atomic Energy Act, States have almost no power regarding the safety of nuclear powerplants. Federal authority, which is embodied in the Nuclear Regulatory Commission, has a virtual monopoly regarding the operation of nuclear plants. Unfortunately, the Nuclear Regulatory Commission has failed to distinguish between plants that are safe and those that are not.

Rather than providing a fair and open forum for resolution of nuclear safety concerns, as well as a mechanism for closing unsafe plants, the NRC has chosen instead to be an advocate of the nuclear industry. Despite all the well documented problems at Pilgrim, the NRC has chosen to keep the plant licensed.

In July of 196—in 1986, I filed on behalf of myself and 49 other State legislators and Massachusetts, Public Interest Research Group and other players, a petition with the NRC requesting a formal hearing on suspension or revocation of Pilgrim's license to operate. Both the Government and the Attorney General has since filed similar show cause petitions with the NRC requesting hearings on the Pilgrim's license.

The NRC's failure to consider fully and fairly and in a timely manner these petitions has convinced us that we cannot rely on the NRC to protect the public from the dangers presented by the Pilgrim nuclear power plant. We urge and respectfully request that you join our efforts by using the power of this committee to demand that the NRC hold formal hearings, so that Boston Edison may demonstrate why it should be allowed to operate a plant that is unsafe, unreliable and uneconomical.

A year and a half ago, I testified at length before the Congressional Subcommittee on Energy Conservation and Power in Washington, DC, on the problems at Pilgrim. Unfortunately very little has changed since that hearing, and the problems what I discussed in that testimony have not been resolved. Accordingly, I would like to submit that testimony again to your committee, and a copy of it has been submitted.[1]

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[1] The testimony referred to appears with the written statement.

The fact of the matter is, Senator, that we need your help. We are in a situation where we have a utility that plans to file for restart of this plan even though they don't have the approved management performance, even though there is no emergency plan to adequately protect the public, even though the containment vessel is flawed and we have a 90 percent rate of failure in the event of a serious accident of the plant, and even though radiological control problems seem to threaten the health of workers and the general public. The NRC has determinedly been an advocate for the industry. It has sought to shut out public participation.

You have opened the door tonight to that public participation to state and local officials and the general public. We deeply appreciate it. We would ask that you continue that effort by using the power of this committee to request the NRC, in fact, hold an evidentiary hearing on why the license of the Boston Edison Co. should not be suspended or revoked.

[Applause.]

The CHAIRMAN. Excellent testimony.

[Booing.]

The CHAIRMAN. Voices of Boston Edison. Let me say we tried to get the NRC to have such a hearing with regard to Seabrook. We were unable to do so. We were joined by just about the whole congressional delegation—and also Senators from New York that—we work together, the Senators from New York [laughter] and we'll continue to try and do so.

I really am troubled by the fact that we can't get such an open hearing. We are going to insist on it, as we did on Seabrook. I mentioned earlier what I would do, if we're unable to get the NRC to open—I would certainly hope that they will. I will take every action I possibly can to see that they do. I know—I'm sure I speak for my colleagues, Senator Kerry and Congressman Studds. But if we're unable to do so, we certainly can testify. I give you my assurance I certainly will, and I'll bring all the testimony that we heard today and try to present it in as effective way as I possibly can. David Malaguti. Is that how it's pronounced? Did I say it right?

Mr. Malaguti.

Mr. MALAGUTI. Yes, Senator. As a matter of fact, you're just fine.

Senator, I'm the chairman of the local Board of Selectmen, and on behalf of my board, I would welcome you to Plymouth. It is a pleasure and an honor to have you here. We would like to see you more often, perhaps, but it is indeed a pleasure. I'm afraid that at this point my testimony, some of it, might be old hat, but I think it is important enough to state again.

The Plymouth Board of Selectmen has discussed at regularly scheduled and posted meetings and has taken the following position. The Pilgrim power station should not be permitted to restart until an effective radiological emergency response plan approved by the town of Plymouth is in place. I quote from the Board's letter to the NRC, dated September 2, 1987.

> The Plymouth Board of Selectmen recommends that the Pilgrim Nuclear Power Station located in our community not be allowed to restart until the radiological emergency response plan of this town is in an effective form.

That position statement was taken after receiving a first report of the town's Committee on Nuclear Matters dated March 1987, and on the advice of the civil defense director. Our position was reiterated in a second letter to the NRC, dated November 16, 1987.

Our present radiological emergency response plan dated May 1985, is inadequate, outdated and has serious deficiencies. While we are working hard to bring into being a new plant that would permit us to provide for the health and safety of our citizens during a radiological emergency, an approved plan does not exist at this time. It will take several more months of work before such a plan can be presented for the action of the Board of Selectmen.

Senator, the magnitude of this problem can be glimpsed if you will just bear in mind two population figures. When Pilgrim station opened in 1972, the population of Plymouth was 19,000. Today it is in excess of 44,000. Our town is 17 miles in length. Stretching along the ocean, we have three major escape routes: Route 3A, Route 44 and the Route 3 Expressway. All routes suffer from traffic gridlocks periodically, especially during the tourist season when people flock throughout our historic town. Winter storms, fall hurricanes, and other adverse weather conditions only exacerbate the problem.

The town of Plymouth is in the best position to assess the public's safety. We are the population most at risk, and we have the experience of the years in dealing with disaster. No public utility must be permitted by the Nuclear Regulatory Agency to dictate a evacuation plan, thereby usurping the traditional powers and authority of the local elected officials. We are not about to surrender our rights to govern ourselves. We are united with our Massachusetts civil defense director, our State public safety director and with our governor. We maintain, as did Governor Dukakis in his letter of December 17, 1987, that the Pilgrim nuclear power station should not be permitted to restart the reactor until all safety issues are resolved, and until adequate approved emergency response plans have been developed by this town and state.

We recommend that your committee exert congressional pressure on the NRC to keep the Pilgrim nuclear power station closed until an effective town-approved emergency plan has been developed for the safety of our citizens and for the protection of their property in this state.

I thank you Senator for the opportunity to testify.

[Additional material supplied follows:]

THE SEL TMEN

September 2, 1987

Honorable Lando Zech
Chairman
Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Zech:

Please convey to the Nuclear Regulatory Commission the consensus of the Plymouth Board of Selectmen which, simply stated, recommends that the Pilgrim Nuclear Power Station located in our community not be allowed to restart until the Radiological Emergency Response Plan of this town is in an effective form. Our present RERP is dated May 1985 and is under intense revision. It is inadequate as to response time, evacuation procedures, and reception centers.

The recent FEMA report to the NRC documents the inadequacies of the Commonwealth of Massachusetts' RERP. The Board of Selectmen recognizes the same flaws in the operative plans of this community.

The public safety would be at risk if the Pilgrim Nuclear Power Station is permitted to open without a valid radiological emergency plan in place.

We remind the NRC that this community of over 40,000 citizens is entirely within the ten mile emergency planning zone and that our geographic location and our few and over-burdened evacuation routes pose serious problems in any emergency plan, whether for natural or radiological disaster.

The issue has been well studied and documented by the Nuclear Matter Advisory Committee of this town as well as by our Civil Defense Director.

Honorable Lando Zech, Chairman
Nuclear Regulatory Commission
September 2, 1987
Page 2

The Plymouth Board of Selectmen recommends that the Pilgrim Nuclear Power Station not be permitted to restart until an effective, tested Radiological Emergency Response Plan is in place.

The public safety ought not to be placed at risk.

Very truly yours,

David F. Malaguti

David F. Malaguti, Chairman
Board of Selectmen
cc Secretary of Public Safety, MA
FEMA, PO Box 70274, Washington DC 20024
Boston Edison, President Sweeney

Nov[illegible] 6, 19[illegible]

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Dear Dr. Murley:

Thank you for your November 2, 1987, letter As you noted in our letter of September 2, 1987, the Plymouth Board of Selectmen had arrived at a consensus that the Pilgrim Nuclear Power Station ought not be granted permission to re-start until an effective Radiological Emergency Response Plan (RERP) was in place. An "effective plan" would be one acceptable to FEMA and bearing its approval.

The Board reiterates this position and, in view of the August 1987 report of the Federal Emergency Management Agency which withdrew interim approval of the existing RERP, the Board feels that the Town of Plymouth's RERP of May 1985 is not only seriously out-dated, but cannot be considered an adequate protection of the public safety during a time of potential radiological danger to our citizens.

We, who are sworn to uphold the public safety, are in the best position to know the present status of planning and readiness in our community, and we ask you to consider our views above all others. It is our town, completely within the Emergency Planning Zone (EPZ), and our citizens, who are most at risk.

To restate our position: The RERP for Plymouth is under intense revision and updating by our Civil Defense organization and our advisory committees. Our present plan dated May 1985 has serious deficiencies and it will take several months before a final draft can be brought to this Board for its consideration.

The restart of the Pilgrim Nuclear Power Station under the foregoing conditions would be dangerous and not in the public welfare.

Page 2

Until such time as there is a FEMA approved RERP which has previously been produced by this community in conjunction with the Civil Defense organizations of the Commonwealth of Massachusetts, the Pilgrim Nuclear Power Station, with its past troubled history, ought not be permitted to restart.

Very truly yours,

BOARD OF SELECTMEN

David F. Malaguti
Chairman

cc Peter W. Agnes, Jr., Assistant Secretary of Public Safety
Robert J. Boulay, Director, Mass. Civil Defense
Peter Forman, Representative
Edward P.Kirby, Senator
Stephen J. Sweeney, President; Boston Edison
Dr. Grace Healy, Chairman; Nuclear Matters Committee

The CHAIRMAN. Ms. Shimshak.

Ms. SHIMSHAK. Thank you, Senator. It's an honor to testify before you tonight, and also to sit with so many distinguished legislative representatives, of which I'm not one.

My name is Rachel Shimshak. I'm an advocate for Massachusetts Public Interest Research Group. MASSPIRG is a statewide organization, working on consumer and environmental protection and energy issues. We have about 150,000 members across the State. I appreciate the opportunity to testify tonight about the historically troubled Pilgrim reactor.

MASSPIRG has followed the problems of Pilgrim over the past decade and has conducted several studies on emergency planning issues and the economic benefits of closing the reactor and investing in alternatives. I've brought with me copies of those reports and I would like to submit them for the record, if I could.

In July of 1986, as Senator Golden mentioned, MASSPIRG, along with many state legislators, elected officials and dozens of citizen groups represented here tonight, submitted a show cause petition to the Nuclear Regulator Commission which detailed management, structural, emergency planning and radiological exposure problems at the reactor. MASSPIRG is certainly not alone in its criticism of the plan. Reports from the NRC, the Department of Public utilities, the Federal Emergency Management Agency, the State Department of Public Safety, and even Boston Edison's own review panel, the Hogan Commission, have detailed their criticism of Boston Edison's management and of Pilgrim's plant. If a horse had as many problems as the Pilgrim plant has, it would have been shot. [Laughter, applause.]

It would be wise to acknowledge Edison's inability to correct these problems and to put the plant out of its misery by closing it permanently.

Today I would like to focus my comments on the conclusions of an emergency planning survey released this fall entitled "No Exit". MASSPIRG's earlier reports generally looked at the adequacy of the emergency plans themselves. This report approached the emergency plans from a different angle. It looked not at the plans themselves, but at the people who would be asked to follow them. Such information is crucial to assessing the feasibility of the plan, particularly in light of the General Accounting Office's finding that, quote, "No Federal agency assesses public knowledge of radiological emergency procedures."

In the summer of 1987, MASSPIRG surveyed 363 residents of the Pilgrim emergency planning zone to determine what people knew about the official emergency plan, and whether they would follow those plans in case of an accident at the plant.

The key findings of this survey show that residents are even less informed about Pilgrim emergency plans then they were at the time of MASSPIRG's last survey conducted in 1983. Moreover, they said they would refuse to follow official instructions in the event of an emergency. Let me just review a few of the findings of the report.

First, residents have only a limited knowledge of emergency plans for their communities. Only 56 percent of those surveyed said that they had received the emergency public information booklet

from Boston Edison, the operators of the plant, compared with 67 percent who remembered receiving the booklet in 1983. Moreover, only 23 percent of those surveyed said they had actually read the booklet, compared to 38 percent in 1983.

Second, many residents would not follow the emergency plan in case of a serious problem at Pilgrim. For instance, the most common response to an accident at Pilgrim, about 27 percent of the people polled, would immediately evacuate; a direct contradiction of the instructions contained in the emergency information booklet. In nice big letters in the booklet, incidently.

Second, only 19 percent of those questioned said that they would go to one of the designated reception centers in case of an evacuation, and two thirds of those few who would follow the emergency plan, would go to the Hanover Mall, which is no longer an official reception center.

Perhaps the most stunning thing that we found concerned school age children. Of the 37 percent surveyed who had school age children, nearly half said that they would try to pick up their school age children from school in the event of an emergency. Again, precisely what the emergency booklet instructed them not to do. Just 9 percent of parents said that they would follow the instructions to meet their children outside the danger zone. And then, just for good measure, 79 percent of the respondents felt that Pilgrim should remain shut down if management and safety problems persist.

Allowing the Pilgrim plant to reopen in light of these results and the serious management and safety problems that persist at the plant, would be like giving a drunk the keys to drive home. MASSPIRG recommends that the Pilgrim plant not be——

The CHAIRMAN. Did they indicate who those 9 percent parents were that were going to leave their children? [Laughter.]

Ms. SHIMSHAK. Nine percent said that they would actually follow, I——

The CHAIRMAN. I guess that doesn't say they would actually leave them.

Ms. SHIMSHAK. Right.

The CHAIRMAN. It doesn't include, as I understand it, the children going to private schools; is that correct?

Ms. SHIMSHAK. There are currently no plans for those people.

The CHAIRMAN. What do they do? Do they stay behind and take that wonderful tablet?

Ms. SHIMSHAK. Perhaps they could wait for the buses, for the buses to arrive from Boston to pick them up.

The CHAIRMAN. A serious question. Do you know the number of children that would be in the private and parochial schools; are there many?

Ms. SHIMSHAK. I'm sure that there are, but perhaps you can.

Mr. MALAGUTI. I don't have the numbers.

The CHAIRMAN. OK, please continue.

Ms. SHIMSHAK. MASSPIRG recommends that the Pilgrim plant not be opened unless it is determined that, one: a workable plan can be developed; two: such plans have been effectively disseminated and implemented, and three: that outstanding management, safety and economic questions have been resolved.

We also recommended that Boston Edison use this unique opportunity to implement the conservation and load management recommendations of the Hogan report, rather than spend more money on this plant. Thank you.

[The prepared statement of Ms. Shimshak follows:]

MASSPIRG

MASSACHUSETTS PUBLIC INTEREST RESEARCH GROUP

Testimony of

Rachel Shimshak

Advocate, Massachusetts Public Interest Research Group

Before the

Labor and Human Resources Committee of the United States Senate

Concerning public health impacts associated with proposed restart of Pilgrim I nuclear power plant

January 7, 1988

29 Temple Place, Boston, MA 02111 (617) 292-4800

Good evening, Mr. Chairman and members of the Committee. My name is Rachel Shimshak and I am an advocate for the Massachusetts Public Interest Research Group (MASSPIRG). MASSPIRG is a statewide organization working on consumer and environmental protection and energy issues. We have over 170,000 citizen members across the state of Massachusetts.

I appreciate the opportunity to appear before you today to discuss the historically troubled Pilgrim reactor. MASSPIRG has followed the problems at Pilgrim over the past decade and has conducted several studies on emergency planning issues and the economic benefits of closing the reactor and investing in alternatives. In July of 1986, MASSPIRG, along with 50 state legislators and over a dozen citizen groups, submitted a "Show Cause" petition to the Nuclear Regulatory Commission (NRC) which detailed management, structural, emergency planning and radiological exposure problems at the reactor.

MASSPIRG is certainly not alone in its criticism of the plant. Reports from the NRC, the Department of Public Utilities, the Federal Emergency Management Agency, the state's Department of Public Safety, and even Boston Edison's own review panel (the Hogan Commission) have detailed their criticism of Boston Edison and the Pilgrim plant. If a horse had as many problems as the Pilgrim plant has, it would have been shot. In our judgment, it would be wise to acknowledge Edison's inability to correct these problems and put the plant out of its misery by closing it permanently.

Today I would like to focus my comments on the conclusions of an emergency planning survey we released this fall entitled, "No Exit." MASSPIRG's earlier reports generally looked at the adequacy of the emergency plans themselves. This report approached the emergency plans from a different angle--it looked not at the plans themselves but at the people who will be asked to follow them. Such information is crucial to assessing the

feasibility of the plans, particularly in light of the General Accounting Office's finding that "no federal agency assesses public knowledge of radiological emergency procedures." (GAO Report to Hon. Edward J. Markey, House of Representatives, "Nuclear Regulation: Public Knowledge of Radiological Emergency Procedures," June 1987, p. 1)

In the summer of 1987, MASSPIRG surveyed 363 residents of the Pilgrim emergency planning zone (EPZ) to determine what people knew about the official emergency plans and whether they would follow those plans in case of an accident at the plant.

The key findings of this survey show that residents are even less informed about Pilgrim emergency plans than they were at the time of MASSPIRG's last such survey, conducted in 1983. Moreover, they refused to follow official instructions in the event of an emergency.

Let me review a few of the findings in the report:

1) Residents have only a limited knowledge of emergency plans for their communities. Only 56% of those surveyed said they had received the Emergency Public Information booklet from Boston Edison, the operator of the plant, compared with 67% who remembered receiving the booklet in 1983. Moreover, only 23% of those surveyed said they had actually read the booklet completely, compared to 38% in 1983.

2) Many residents would not follow the emergency plans in case of a serious problem at Pilgim:

* the most common response to an accident at Pilgrim (27% of those polled) would be immediate evacuation--a direct contradiction of instructions contained in the emergency information booklet;

* only 19% of those questioned said they would go to one of the designated reception centers in case of an evacuation, and two-thirds

of these few who would follow the emergency plans would go to the Hanover Mall, which is no longer an official reception center;

* of the 37% surveyed who have school-age children, nearly half (48%) said that they would try to pick up their children from school in the event of an emergency--precisely what the emergency booklet instructs them not to do; just 9% of parents said they would follow the instructions to meet their children outside the danger zone.

* Seventy-nine percent of the respondents felt that Pilgrim should remain shut down if management and safety problems persist.

Allowing the Pilgrim plant to reopen in light of these results and the serious management and safety problems that persist at the plant would be like giving a drunk the keys to drive home. MASSPIRG recommends that the Pilgrim plant not reopen unless it is determined that:

1) workable plans can be developed;

2) such plans have been effectively disseminated and implemented; and

3) outstanding managment, safety, and economic questions have been resolved.

We also recommend that Boston Ediston use this unique opportunity to implement the conservation and load managment recommendations of the Hogan report rather than spend more money on this plant.

Thank you very much.

The CHAIRMAN. I want to move along, but I have some questions. First of the legislators. First of all, I congratulate you on the report that was made for the Joint Special Committee, and I'm going to make the recommendation contained in the report a part of the hearing record as well.

Representative Forman spoke about the adequacy of the ability of local and State governments to deal with some of the NRC rulings.

Do you have suggestions of ways in which the NRC should expand the role of the State and local communities? Or if you want to think about it, you can later make it a part of the record.

[Excerpts from the report referred to above follows:]

SENATE . . . . No. 2023

The Commonwealth of Massachusetts

REPORT

of the

JOINT SPECIAL COMMITTEE
ESTABLISHED FOR THE PURPOSE
OF MAKING AN INVESTIGATION AND STUDY

Relative to

THE PILGRIM NUCLEAR GENERATING
FACILITY AT PLYMOUTH

(under the provisions
of Senate Order No. 2044
adopted in the year 1986).

July, 1987

The Commonwealth of Massachusetts

FOREWORD

The Pilgrim Nuclear Generating Station has been shut down since April 1986. The Nuclear Regulatory Commission has been sharply critical of the Boston Edison Company's management of the plant.

The Massachusetts Legislature responded with the establishment of a special joint committee to investigate and study the problems at the facility. This report is the culmination of the committee's work.

We recognize that this is not the final work on Pilgrim. Debate over Boston Edison's improvements, possible re-start, and how fully our recommendations are followed will continue. We also recognize that state authority over nuclear power is limited. Thus our recommendations should be seen in that light.

We do hope, however, that the report will serve as a major reference point as public debate continues and decisions are made. As Chairmen of the committee, our aim was to provide an open forum where all the issues could be reviewed objectively.

We have succeeded in our efforts if the report contributes to the enhancement of public safety and public health in the Commonwealth.

Finally, we wish to thank the committee members for their hard work and patience, as well as the individuals and agencies identified herein that contributed greatly to this report.

SENATOR THOMAS C. NORTON,
Senate Chairman.

REPRESENTATIVE PETER FORMAN,
House Chairman.

This report has been prepared by Brian J. Prenda, M.P.A., Lisa Kaminski, Kevin Considine, Linda Marley and Lucy DeLaney for the Special Committee to investigate and study the Pilgrim Station Nuclear facility at Plymouth.

The staff of the Special Committee extends its sincere thanks to those who so generously contributed their time and expertise to the preparation of this report.

RECOMMENDATIONS

I) Creation of the Division of Nuclear Facilities Safety.

II) Endorsement of Comprehensive Load Management and Conservation Programs.

III) Prioritize Massachusetts Based Electrical Generating Facilities.

IV) Department of Public Utilities to Establish a Five-year Supply Plan without reliance on the Pilgrim Plant.

V) Committee Review of the Nuclear Regulatory Commission (NRC) Systematic Assessment of Licensee Performance Report (SALP) and Recommended Measures to Correct Serious Functional Deficiencies at the Pilgrim Nuclear Generating Facility at Plymouth.

VI) Improved Emergency Preparedness Plan.

RECOMMENDATION I

CREATION OF A DIVISION OF NUCLEAR FACILITY SAFETY

After many hours of deliberation over topics such as emergency preparedness and planning, monitoring of radiation and other aspects of nuclear safety, the committee has concluded that many areas regarding public safety need immediate attention and improvement. After reviewing and hearing the testimony of the Department of Public Health (DPH) and the Department of Public Safety, the committee concluded that lack of funding, along with shortfalls in strict compliance with many sections of Chapter 796 of the acts of 1979, have led to a less than appropriate handling of radiation monitoring and emergency preparedness. The committee, therefore, recommends that the Commonwealth adopt and implement the formation of a Division of Nuclear Facility Safety to oversee nuclear generated power production in the Commonwealth.

The Division of Nuclear Facility Safety shall provide the following provisions and services:

The Division of Nuclear Facility Safety shall be a division of the Department of Public Safety and shall be responsible for monitoring the operation and modification of the two nuclear power plants within the Commonwealth. In addition, it shall be responsible for developing emergency response plans in conjunction with Massachusetts Civil Defense for responding to accidents involving nuclear power plant facilities. Major activities shall include: installation, operation and maintenance of a system for remote monitoring of radioactive discharges from the nuclear power plants, in conjunction and under the supervision of the Department of Public Health; development and review of the Massachusetts Radiological Accident Emergency Preparedness Plan (MRAEPP); oversight of training of state and local civil defense personnel responsible for implementation of the MRAEPP. Enforcement of rules and regulations prescribing standards for in service testing of pressurized systems at nuclear power plants which the Department of Public Safety oversees.

1) The Massachusetts Radiological Accident Emergency Preparedness Plan.

The Massachusetts Radiological Accident Emergency Prepared-

ness Plan shall establish a program for statewide, integral management procedures in the event of an accident which may occur at a nuclear power reactor site. The primary purpose of the plan is to provide a coordinated response by state and local governmental officials for the protection of the citizens of the Commonwealth. The plan shall include site specific planning to cover the urgency of protecting citizens living near nuclear plants; a concept of operations so that the plan can be effectively carried out; and an effective allocation of resources and personnel. The plan shall pre-assign the duties and responsibilities that would be taken by all the respondents to a nuclear accident thus enabling actions to be made quickly and efficiently.

The Massachusetts Division of Nuclear Facility Safety and the Massachusetts Civil Defense Agency shall share the primary responsibility for developing the plan with integral component agencies such as the state police and the Emergency Planning Zone (EPZ) communities' local officials. The utilities' security and safety personnel must also play a major role in planning. Specifically, the Division of Nuclear Facility Safety shall be responsible for the technical functions of this effort, and the Civil Defense Agency shall be responsible for the operational aspects. The plan shall be reviewed every year for accuracy and proper appropriation to assure a fully functional quality plan. The appropriate components shall be distributed to the proper state, county and municipal agencies and organizations in the Commonwealth for implementation.

The Division of Nuclear Facility Safety shall plan to expand the EPZ to 50 miles from each reactor with the understanding that greater planning and preparedness efforts are necessary closer to the reactor and that evacuation will not likely be recommended for all areas within a 50-mile radius. These plans should be tailored to meet each community's specific needs.

The Division of Nuclear Facility Safety shall clarify evacuation plans for regional schools which have students from at least one, but not all, towns in the school system which are part of an EPZ. Division and Civil Defense officials working with school administrators and parents' groups must develop workable student and teacher evacuation plans and establish criteria for determining when, if ever, it would be appropriate to send children home first to evacuate with their families.

The Division of Nuclear Facility Safety shall establish emergency

evacuation time estimates and traffic control plans based on evacuations of people within the EPZ to reception centers at least 30 miles from the reactor and should anticipate secondary or shadow evacuations.

The Division of Nuclear Facility Safety shall commission a site-specific probabilistic risk analysis of severe accident probabilities at Pilgrim and the consequences of radioactive releases and the probable health effects at various distances from the plant.

Major operations specified in the Plan and agency responsibilities are outlined in Recommendation VI.

2) Monitoring.

The committee recommends that the Division of Nuclear Facility Safety and the Department of Public Health adopt and develop a Remote Monitoring System (RMS) which shall incorporate three major components: gross gamma detectors radially positioned around each nuclear power station; an automated, isotopic gaseous effluent monitor system which samples from major engineering release points; and a reactor parameter data communication link to each facilities' on-site computer. In addition there shall be provided liquid effluent monitors, which will be located at each plant's liquid discharge points. All of these RMS components shall be connected through a dedicated data communications link to provide instantaneous readings to the Division of Nuclear Facility Safety Headquarters. Technical staff shall review the data and perform analyses of plant conditions.

a) ENVIRONMENTAL RADIATION MONITORING SYSTEM: The Division of Nuclear Facility Safety shall develop a dual ring system of environmental radiation monitors utilizing gross gamma detectors and automated isotopic detectors which shall be installed and maintained around each reactor site that would measure a change in radiation levels resulting from a radioactive release at the reactor site. This system shall serve a multitude of purposes. It shall define the existence of a radioactive release sufficiently large enough to impact upon the environment, as well as detect a release through an unmonitored release path. In addition, the system shall provide a backup capability should the effluent monitoring system be inoperable, and shall also help reveal the presence of atmospheric conditions (windshear) which could result in plume dispersal not following anticipated direction of travel.

The Environmental Radiation Monitoring System shall be

developed to provide the following features: (1) up to 16 monitors per site (1 detector for each 22.5 degree segment) at a distance of approximately 2 miles from the reactor site; (2) minimum detection level of 1 microRoentgen per hour (natural background levels are approximately 7 to 10 microRoentgens per hour); (3) maximum detection limit is at least 10 Roentgens per hour (one million times normal background levels); (4) automatic transmission of radiation readings to the Nuclear Facility Safety Division headquarters computer system every 8 minutes; and (5) transmission of alarm signals to the Nuclear Facility Safety Division headquarters in the event of high radiation levels or failure of environmental monitoring system components.

b) REACTOR PARAMETER DATA LINK: The Massachusetts Division of Nuclear Facility Safety shall install a direct data communication link between the Division headquarters computer and each nuclear reactor's control room computer for the monitoring of the Commonwealth's two nuclear power reactors and their safety systems. This data link shall be developed for early notification of events that could lead to nuclear accidents. This system is an essential element in providing continuous plant safety assessment, early detection of abnormal conditions, and evaluation of nuclear plant transients.

The system signals to be received at the Division's headquarters shall be the same signals available to the nuclear plant personnel on-site. The Division shall select particular parameters to be transmitted to them from an index containing all available plant system information. Parameters selected by the Department provide detailed information on the operation characteristics of all essential plant safety systems.

Some major features that are available that may be included in this system are: (1) 1,000 to 1,300 parameters (signals) per reactor accessible for transmission every two minutes; (2) technical parameters include: reactor power levels, reactor water levels, steam generator water levels, containment temperatures, engineered safety system availability, and essential pump flow rates; and (3) system software for displaying either current or historical signals.

c) THE RADIOACTIVE GASEOUS EFFLUENT MONITORING SYSTEM: The Division of Nuclear Facility Safety and the Department of Public Health shall be directed to utilize and

implement a custom designed automated system to monitor gases routinely released by nuclear power plants. The Radioactive Gaseous Monitoring System is designed to identify and quantify the radioactive components of the gaseous discharges from each stack and other gaseous release points to the environment and transmit the information immediately to the Division so that appropriate emergency action can be directed in the event of a nuclear accident.

The Radioactive Gaseous Effluent Monitoring System is a state of the art, computerized system which continuously transmits data from the nuclear power plant to the Division's headquarter computer.

This system includes the following features: (1) dedicated computer at the power plant sites for operation and analysis; (2) minimum detection level of 10 to 13 microCuries/cubic centimeter; (3) maximum accident detection limit of 10 microCuries/cubic centimeter; (4) collection and analyses of radiation in three forms: iodines, particulates, and noble gases; (5) automatic background level checks; (6) automatic check on source verifications; (7) remote computer access to determine operational status and data; (8) signal alarms in the event of high radiation levels or failure of a system function; (9) detection of specific isotopes based on radiation energy; and (10) accelerated operation rates designed to maximize data collection during an accident.

d) EMISSION STANDARDS: It is essential that Massachusetts Public Health Officials review and determine the maximum permissible levels of airborne radioactive emissions from nuclear power plants that do not threaten the public health and safety. By adopting state emission standards as authorized by the Clean Air Act amendments of 1977, the Commonwealth will ensure that safe standards are in place and strictly enforced. Until such standards are set by the Department of Public Health, the federal standards should be adopted as state standards so that the state officials immediately have the power to inspect onsite and off-site monitoring equipment and have independent enforcement authority over emissions. The state shall assess all licensees for the cost of setting up a monitoring system for the Commonwealth.

Perhaps the most important safety function of a monitoring system is to assist emergency response officials in determining the extent of a serious accident and the amount and direction of radiation releases. We recommend installation of a comprehensive and sophisticated new

monitoring system similar to the one that is already installed and functioning in Illinois to provide substantially more public protection.

3) Possible Adverse Health Effects From Pilgrim Radioactive Emissions

a) Radiation exposure can cause cancer, birth defects and chromosomal damage. The Department of Public Health has determined that there has been a significant increase in leukemia cases in the area surrounding Pilgrim, although the department is still studying what the cause of those leukemias may be.

b) The Special Committee recommends that four health studies be conducted:

1) A follow-up study on the leukemia cases in the Plymouth area to determine what environmental or occupational exposures may have caused those leukemias.

2) A study to test the theory that coastal winds may concentrate the radioactive emissions from the Pilgrim plant in such a way as to cause adverse health consequences in coastal areas.

3) A regional study of adverse health impacts, including leukemia incidences, birth defects and infant mortality, downwind from other nuclear reactors in New England.

4) A health study of all past and present Pilgrim employees to determine the adverse effects, if any, of exposure to radiation from Pilgrim.

4) The cost of the Division of Nuclear Facility Safety and the Department of Public Health's monitoring system should not be borne by all taxpayers but by the utility ratepayers through an assessment of the nuclear plant licensees.

RECOMMENDATION II

ENDORSEMENT OF COMPREHENSIVE LOAD MANAGEMENT AND CONSERVATION PROGRAMS

The special committee investigating the Pilgrim Nuclear Generating Facility reviewed testimony involving energy supply, load management and conservation measures during several hearings. The committee concluded that in order to meet current and future power supply demands all utilities in the Commonwealth must implement stringent load management and conservation programming. The committee stresses that authority should be given to the Department of Public Utilities to oversee the implementation of aggressive load management and conservation programs for any electric utility relying on the continual operation of the Pilgrim Generating Facility.

Load Management

The committee endorses the concepts contained in the *Final Report of the Boston Edison Review Panel* as they relate to increased load management programs by Boston Edison Company. The committee recommends that the Department of Public Utilities (DPU) be required to encourage and assist Boston Edison in implementing the specific load management programs. The DPU shall also be required to encourage and assist Commonwealth Electric Company in implementing appropriate cost-effective load management programs that offer the company similar energy-saving results.

Boston Edison Company should identify and fund effective "load management" measures, such as radio-controlled water heaters and nighttime water chilling systems, which reduce peak energy use and are cheaper than the cost of producing electricity from new power plants. In addition, the utility should provide incentives for commercial and industrial sector customers to form "load-shedding cooperatives," where a group of participants agrees to share minimal energy use reductions during peak demand emergencies.

Conservation

The special committee endorses the concepts contained in the *Final Report of the Boston Edison Review Panel* as they relate to increased, cost-effective conservation programs by Boston Edison Company. The DPU should be required to encourage and assist Boston Edison in implementing the specific conservation programs. The DPU shall also be required to encourage and assist Commonwealth Electric Company in implementing appropriate, cost-effective conservation programs that offer the company similar energy-saving results. The DPU should direct all utilities to make significant investments in energy conservation and energy efficiency programs, known as "demand-side management" programs, to reduce the energy demand of all utilities' customers. The DPU should set target investment levels and participate in the design of demand-side management programs. Such programs should include, but not be limited to the following, where shown to be cost effective:

1) The special committee recommends all utilities should employ design teams to go into buildings that use large quantities of electricity to identify the full package of demand-side management measures and practices that are cheaper than the utilities commensurate cost of producing electricity from new power plants over the useful life of the conservation measures. The utility should then fund the purchase and installation of identified cost-effective measures.

2) All electric utility companies should offer their customers incentives for a wide range of efficiency measures. This incentive program should go far beyond the limited scope of current and prior utility rebate programs for refrigerators and efficient lights.

3) All electric utility companies should also provide incentives for electrical energy efficiency in new construction including hook-up fee and penalties.

4) All electric utility companies should convene an auction for energy efficiency improvements similar to the bidding process that is currently being used to promote the development of small power and co-generation facilities.

5) The committee recommends that the DPU should be allowed to provide all utilities with a profit, or "rate of return" on the investment the company makes in demand-side management programs. This rate of return, to be recovered from the company's ratepayers, could be at least as high and/or up to two percentage points higher than the rate the utilities are authorized to receive for capital investments in new power plants.

RECOMMENDATION III

PRIORITIZE MASSACHUSETTS BASED ELECTRICAL GENERATING FACILITIES

I. The Committee recommends that the Energy Facilities Siting Council and the Department of Public Utilities give priority consideration to the construction of non-nuclear electric generating plants located within the Commonwealth when reviewing the plans of any electric utility for the construction of a new generating plant.

The Massachusetts General Laws and regulations promulgated by regulatory agencies require utility companies to provide ratepayers with electricity at the lowest possible economic cost and with the least possible environmental impact. In planning to meet the electrical energy needs of ratepayers, the Department of Public Utilities, the Energy Facilities Siting Council, and the utilities should consider and evaluate the following factors:

1) The full "life cycle" economic costs of each energy resource option. These include costs for construction, financing, operation and maintenance, and decommissioning. With respect to energy efficiency and load management programs, costs for materials and installation and program administration should be considered.

2) The full environmental costs of each energy resource option. Environmental impacts associated with the siting of facilities, degradation of outdoor and indoor air quality, potentially adverse impacts on water quality, and risks to public health should all be fully considered when deciding which energy option to pursue.

3) The number of jobs created by the use of each energy resource option. The number of long- and short-term jobs that are directly and indirectly created as a result of developing various energy resource options should be considered and compared. Other state and local economic development costs and benefits, such as support of indigenous industry and inflows or outflows of

capital resulting from development of each energy resource option should also be considered.

4) The reliability of the energy resource option. Massachusetts needs affordable and reliable energy resources to help sustain a healthy economy. Energy resource options that decentralize and diversify the region's fuel mix, and which reduce reliance on non-indigeous fuels, should be prioritized.

All potential resource options — including energy efficiency improvements and practices, load management measures and practices, small power production, co-generation, and small and large oil, natural gas and clean coal technologies should be evaluated and compared using the above criteria.

The Committee believes that priority should be given to Massachusetts based plants. The Committee is concerned about the increased dependence on plants located outside Massachusetts for our electric generating needs. It believes that this trend increases the likelihood of supply disruptions, thereby complicating unduly our ability to forecast long range supply. This trend of reliance on plants outside Massachusetts is also detrimental to our economy, since it creates jobs in other states that would otherwise benefit Massachusetts workers.

RECOMMENDATION IV

DEPARTMENT OF PUBLIC UTILITIES TO ESTABLISH A FIVE-YEAR SUPPLY PLAN WITHOUT RELIANCE ON THE PILGRIM PLANT

The Committee has found that the Pilgrim Nuclear Generating Facility at Plymouth, Massachusetts has suffered from serious and continuous mismanagement. Although significant efforts are being made by its owners to rectify the management problems, considerable uncertainty remains over the reliability of the plant to contribute to the electric supply needs of the Commonwealth.

The Committee therefore recommends that the Department of Public Utilities (DPU) establish a five-year plan for ensuring adequate supply without consideration of the electrical production of Pilgrim plant. Due to the uncertain future of Pilgrim, the DPU should establish a supply plan for the Commonwealth that does not require any dependence on the Pilgrim plant. Such plan shall include a forecast of future supply and demand which delineates each source of power and its location. January 1, 1988 is the due date for the implementation of the initial five-year plan.

The Committee recommends that in determining whether to restart the Pilgrim Nuclear Power Plant, the availability of sufficient cost effective and safe alternate energy resources shall be taken into consideration.

RECOMMENDATION V

COMMITTEE REVIEW OF THE NUCLEAR REGULATORY COMMISSION (NRC) SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE REPORT (SALP) AND RECOMMENDED MEASURES TO CORRECT SERIOUS FUNCTIONAL DEFICIENCIES AT THE PILGRIM NUCLEAR GENERATING FACILITY AT PLYMOUTH

The Pilgrim nuclear power plant has a well documented, and well publicized, history of problems. This history has called into question both the level of safety when Pilgrim is operating and Boston Edison's ability to run the plant. With an issue as emotional as nuclear power, the loss of public confidence must be addressed in addition to the actual safety problems.

Massachusetts, particularly residents of Southeastern Massachusetts, have every right to demand that Pilgrim be one of the best run plants in the country rather than one of the worst. Clearly the initiative for this belongs to Boston Edison. Pilgrim has been "off-line" for more than a year. During that time the utility has undertaken significant initiatives to improve its performance. In some cases they have taken a lead in the nuclear industry to address certain problems. More work remains to be done, however, and how effective the company is in its work will have to be judged when it is completed.

This is neither a "pro-nuclear" nor an "anti-nuclear" report. The committee feels that where there are problems, they must be addressed, prior to restart, and that the plant should not operate until all major deficiencies are corrected. Individual members will have their own views on nuclear power but everyone agreed that the overriding issue here was not to resolve the nuclear debate but to address the problems of one particular plant.

The committee heard testimony on specific operations and plant problems from Boston Edison, the Nuclear Regulatory Commission, and representatives from citizen groups. In addition, the committee has had access to Public Safety Secretary Charles Barry's report to the Governor on the plant and volumes of NRC reports.

To try and identify every single problem and the appropriate solutions would be beyond the committee's capability and jurisdiction. The sheer number of technical matters, the lack of expert staff, and the debate within scientific and regulatory circles over some issues made it unrealistic for us to devise the specific solutions to many particular problems. Likewise, it makes little sense to list every specific problem since it would make more difficult our aim to focus public attention on the most substantive problems.

The committee does feel, though, that it is useful for the Legislature to summarize the patterns of problems and our perceptions of the work which needs to be done. This, we hope, will not only focus greater attention on the major problems but also give the Legislature and the public some standard by which we can measure Edison's progress.

The NRC, on many occasions, has claimed it will force Edison to prove significant improvements before restart is allowed. As part of their process they will develop a detailed check list of matters requiring solutions. The committee urges the NRC to include our concerns as part of that process. If addressed, we feel plant safety will be enhanced and public confidence raised.

The Nuclear Regulatory Commission recently issued the Pilgrim Systematic Assessment of Licensee Performance (SALP) for the 15-month period of November 1, 1985 through January 31, 1987. SALP is a comprehensive assessment of the plant analyzed into twelve functional areas. The report identifies recurring programmatic weaknesses in five functional areas including: radiological controls; surveillance; fire protection; security; and assurance of quality.

These five functional areas received low SALP grades of 3. The NRC rates on a 1, 2, and 3 basis and defines a 3, the lowest rating, as follows:

> "Both NRC and licensee attention should be increased. Licensee management attention or involvement is acceptable and considered nuclear safety, but weaknesses are evident; licensee resources appear to be strained or not effectively used so that minimally satisfactory performance with respect to operational safety is being achieved."

The following is an outline of the problems in each of the five functional areas as reported by the NRC, followed by the committee's recommendations.

(1) RADIOLOGICAL CONTROL: "This assessment covers radiation protection, effluent monitoring and controls, radwaste shipping and environmental monitoring. SALP found that the licensee made numerous improvements in the overall quality of the radiological controls program. However, implementation of the program continues to be weak. When problems with program implementation or adequacy are identified, corrective actions are sometimes not adequate or not implemented resulting in the need for further NRC involvement. In the area of effluent monitoring and control, the licensee implemented the new effluent technical specifications in a generally acceptable manner, however, failure to take action on significant long standing deficiencies in the environmental Thermolumenescent Dosimeters (TLD) program detracted from the good effort."

COMMITTEE RECOMMENDATIONS:

a) — Aggressively supervise the radiological control program.
b) — Establish and implement measures to verify program implementation and implement corrective actions for deficiencies.
c) — Interactions with personnel outside the radiological group should be significantly strengthened.
d) — Continued clean up of plant and reduction of contaminated areas.
e) — Strengthen the role and company jurisdiction of radiation control department over the other departments.
f) — Exposure histories of past and present employees and contracted workers be compiled, continually updated, and reported to DPH and Nuclear Facility Safety Division.
g) — Improve programs for replacement of thermoluminescent dosimeters.
h) — Improve training of employees in radiological environmental technical specifications.
i) — Improve control and accounting of special nuclear material under one gram.
j) — Improved access control to high radiation areas.
k) — Improved inspection of vehicles leaving site for any contamination.

(2) SURVEILLANCE: "Individual surveillance tests were well conducted and controlled. The response to recurring local leak rate test failures was also positive. However, the licensee has been slow to recognize and correct weaknesses in the control of the program tests. This lack of progress is reflected in the large number of surveillance-related licensee event reports and NRC violations issued during the current period. The control of the program is fragmented and not always effective and appears to depend more on historical past practice then in a well-founded, systematic approach. This is a major weakness that must be corrected. The licensee's measuring and test equipment control program also need improvement."

COMMITTEE RECOMMENDATIONS:

a)—Significant site and corporate management attention is needed to correct deficiencies in this area.
b)—Place a single qualified individual in overall charge of the surveillance program.

(3) FIRE PROTECTION: "The licensee has been slow to strengthen the fire protection program. Problems included inadequate surveillance procedures, degraded fire barriers, inoperable fire protection system equipment, and poor quality fire brigade training. Although action has been taken to address these concerns the program has suffered from a chronic lack of attention and should be closely monitored."

COMMITTEE RECOMMENDATIONS:

a)—Significantly reduce the amount of inoperable fire protection equipment in the station.
b)—System for assessing priority needs and timely correction of any deficiencies in fire barriers and protection equipment.
c)—Improved supervision and training of fire watchers.
d)—Provision for independent water and power supplies.
e)—Completion of all Appendix R improvements.
f)—System to control combustible material on-site.

(4) SECURITY AND SAFEGUARDS: "The previous SALP report identified serious NRC concerns regarding the licensee's

awareness of, and attention to, NRC physical security objectives and the need for additional management attention to, and support of, the security program to insure that the program was properly implemented. The previous SALP report also identified NRC's belief that the licensee had initiated actions to resolve those concerns and that the security program was receiving increased management attention. However, shortly after the beginning of this assessment period, it became apparent to the NRC that, due to the number and complexity of the identified problems and some other problems which were then surfaced, far more extensive management attention and resources would be required. As evidenced during this assessment period, the need for additional attention and resources by the licensee continued until late in this assessment period. As a result, little physical progress toward improving the program was accomplished by the licensee during the period."

COMMITTEE RECOMMENDATIONS:

a)—High level corporate and site management attention to the recently established priority level for the security program upgrade should continue in order to implement commitments and develop an effective program.

b)—NRC/Boston Edison review of relationship of contracted security force over Boston Edison and other contracted employees. Does Security have adequate power to control plant personnel and question employee activities?

c)—Develop and implement effective program to eliminate any presence or use of alcohol and drugs.

d)—Elimination of any violations or weaknesses in security barriers.

(5) ASSURANCE OF QUALITY: "Although the licensee has exhibited good performance in certain activities such as outage control and engineering and has displayed initiative in its safety enhancement program, significant deficiencies still were found to exist in radiological controls, surveillance, fire protection and security. Some of these deficiencies have existed

throughout the period and have been identified in previous SALP reviews, and by the licensee's own quality assurance organization. The ambiguity of the site organizational structure and the instability in the corporate and site management team have resulted in the licensee's inability to address and resolve these long-standing problems without repeated prompting and overview by NRC. Senior corporate management was slow in confronting the problems and in implementing corrective actions. Late in this assessment period and immediately following it, the licensee took steps to address its organization weaknesses. However, the effectiveness of these efforts in improving the licensee's performance remains a matter of continuing NRC interest and concern."

COMMITTEE RECOMMENDATIONS:

a)—Continue senior management attention to identify problems to ensure that they are promptly and effectively resolved.
b)—Improve tests and surveillance of equipment program.
c)—Greater authority of quality control staff over other departments to resolve any conflicts between procedures and personnel in different operation groups.
d)—Improve training and supervision over contract workers.
e)—Improvements in visual surveillance system to properly identify and describe deficiencies.
f)—Improve training, testing and requalification of personnel.

(6) PLANT/EQUIPMENT

COMMITTEE RECOMMENDATIONS:

a)—Maintenance requests back log be eliminated.
b)—Complete review of maintenance and testing schedules with all incomplete testing being finished and any deficiencies corrected.
c)—Identification and repair of Main Stream Isolation Valve and RHR pumps which caused initial spurious scram which closed the plant.
d)—NRC investigation and public explanation of recent reports of deficiencies in certain General Electric reactors, including Pilgrim. The public should be informed of the possible

problems and any action taken by General Electric or Boston Edison which has corrected these deficiencies. All uncorrected problems should be corrected.

e)—The NRC and General Electric should also make available to the public the General Electric report.

(7) GENERAL MANAGEMENT CONCERNS: The following are recommendations which address general management areas which the committee feels need review.

COMMITTEE RECOMMENDATIONS:

a)—Staff vacancies in key areas should be filled to adequate levels.

b)—Demonstration that the new programs, divisions and personnel can actually perform as planned.

c)—Resolution of inter-group conflicts and clearer lines of authority for safety, ALARA (As low as reasonably achievable), and fire protection personnel over other divisions.

d)—Review and planning of transition from outage and maintenance mode to on-line operation so that they are prepared if restart is approved.

(8) REACTOR CONTAINMENT: In its most recent SALP report the NRC noted the following: "Plant hardware changes were also impressive, particularly the planned Mark I containment enhancements. The modifications go considerably beyond NRC recommendations and show a concern for nuclear safety." Nevertheless, serious concerns have been raised, both inside and outside of the NRC, about the Mark I containment and its possible failure in the event of a major accident. The Committee has sent a letter to Boston Edison seeking more information on exactly what work is planned to enhance the containment system. In addition, the committee strongly urges that prior to restart the NRC, the state, and Boston Edison shall hold a public hearing on:

a) The possible defects or weaknesses of the Mark I containment;
b) the work planned by Boston Edison to improve it;
c) the schedule for that work;
d) NRC studies and others done on the integrity or possible failure of the containment in the event of a major accident. The containment is such a crucial safety feature in nuclear plants that

all work to strengthen any weaknesses must be completed prior to restart.

e) An evaluation of any additional safety features such as filtered venting of the containment, molten core barriers, underground residual heat removal system, and a secondary steel containment.

(9) STANDBY GAS TREATMENT SYSTEM: Prior to refueling the problems identified with the Standby Gas Treatment System should be corrected.

(10) DECOMMISSIONING PLAN: It is unclear what happens to the plant and storage of radioactive waste when the plant is permanently closed. The questions of the cost involved decommissioning, the impact on Plymouth taxes, waste storage, security, and dismantling or "sealing" of the reactor building are of great concern to area residents. The NRC, the state and Boston Edison should develop decommissioning plans, well before a scheduled closing, to answer these and other questions.

The Committee after intensive review of the NRC SALP report recommends the Boston Edison Company immediately take positive action on all of the above recommendations. Boston Edison should improve all of the categories which received grades of category 3 on the most recent SALP report. The two primary causes for the NRC's category 3 findings were slowness in making improvements and lack of management attention. These problems should be resolved so that none of the functional areas maintains a category 3 grade. It is imperative that all improvements are completed before action is taken to restart the Pilgrim Nuclear Power generating facility at Plymouth.

RECOMMENDATION VI

IMPROVED EMERGENCY PREPAREDNESS PLANNING

Emergency preparedness is the last layer of protection for public health and safety in the event of an accident at a nuclear plant. Until recently, emergency planning seems to have been perceived more as a regulatory requirement than a form of protection which might be called into use. As public concern over nuclear plants has increased over the past year, so has emergency planning come under greater scrutiny.

This scrutiny has found the obvious current emergency planning is inadequate. The primary responsibility to correct these inadequacies rests with the state. Working with federal officials, local officials, and the utility the state must take immediate action to develop plans that are more realistic and dependable.

The federal government has reserved to itself most powers dealing with nuclear power plants. The state, however, is left with almost total responsibility in protecting the public should an accident ever happen. While this may be jurisdictionally awkward there is no substitute for state and local planning. Local and state officials are the most qualified to prepare and implement emergency plans.

It is unacceptable to this committee for a private utility or federal agency to try and fulfill or usurp state and local responsibility. The committee feels that prior to restart emergency plans must first be reviewed and approved by town officials, in the Emergency Planning Zone (EPZ) communities, and by the state. Nuclear Regulatory Commission (NRC), Federal Emergency Management Agency (FEMA), Boston Edison, the State, and towns should work on a schedule to coordinate the review and decision on whether to approve, prior to restart.

There is growing debate over how far states can use the planning approval requirement as a means of preventing a new plant from being licensed or of closing a licensed plant, if a state does not believe an emergency response plan can adequately protect the public health and safety. It appears that the NRC, Congress, and undoubtedly the courts will be reviewing this issue as more states withhold approvals.

The state should pursue two courses. State and local governments should develop the strongest possible emergency plans. The public's

health and safety demands nothing less. If, after those plans are developed, the Governor feels they are still inadequate then he may withhold approval.

The committee heard testimony from the Department of Public Safety about the need to plan beyond a set limit of ten miles. The Department stressed, though, that with deficiencies in current ten mile planning any work beyond the ten mile zone should not deflect any attention from the communities within the zone. Communities closest to the plant require a higher level of planning than communities farther away. The Department also testified that while Civil Defense is the primary agency for dealing with emergencies other divisions are involved such as the National Guard, Public Safety, and Public Health. The Department noted that coordination between state agencies for nuclear emergency planning needs to be improved.

Local Civil Defense officials from several towns in the EPZ testified before the committee. Their concerns included:

A) Lack of a reception/decontamination area;

B) A need for greater technical and material assistance from the state and utility;

C) Criticism that the plans lacked specific written agreements with parties which might be involved with an emergency, such as bus companies and hospitals;

D) A need to plan for regional school systems in which students come from one but not all towns within the EPZ; and

E) The need for more inter-community planning in order to have a coordinated regional plan.

The town of Plymouth has created its own local advisory committee on nuclear matters. That committee has thoroughly reviewed the town's emergency response plan. Their report has been made available to the committee and demonstrates the kind of detailed planning necessary for a strong response plan. It also demonstrates the indispensable role of local governments in developing plans. Many of their recommendations would be helpful to other towns. Their report is included (see Appendix 9).

While primary responsibility for planning rests with state and local officials there is necessary assistance which should come from the utility. This includes technical advice as well as material support accepted by the state, a county, or a town. The committee feels that this assistance should be paid for through utility assessments which will be passed on to utility ratepayers rather than all taxpayers.

Specific improvements to the emergency plans need to come from the utility, towns and state. The committee recommends the following improvements:

BOSTON EDISON PLANNING ASSISTANCE:

(1) Boston Edison Company should provide updated and accurate Evacuation Time Estimates under a wide variety of accident scenarios. This will enable state and local officials to better plan traffic management in the event of an emergency.

(2) Identification, notification and workable evacuation plans for mobility impaired and individuals who will have difficulty being notified of an emergency or in being familiar with the emergency response procedure. Such individuals include the physically disabled, those depending on public transportation, the hard of hearing and those who speak limited English. Greater attention to these individuals will help ensure that no one is excluded from the planning.

BOSTON EDISON EQUIPMENT:

(1) Boston Edison should improve Public Alert Systems including testing. Sirens should be tested more frequently with improved monitoring and identification of individual siren deficiencies. Siren systems should be audible in the entire EPZ, and loud enough to be heard in buildings with closed windows. In addition, this system should be supplemented with an adequate number of loudspeaker equipped vehicles.

(2) Review and supply of needed equipment for shelters and reception areas for evacuations. During summer months local population swells, increasing the need for sheltering areas for non-resident visitors.

(3) Provide greater information in the event of an emergency. During an incident, people may not have written information on hand about procedures to be followed. This is particularly true for non-residents. Printed material with procedures for an emergency should be pre-printed for quick distribution in group shelters, relocation areas, hospitals, public transportation, and through school children during an emergency.

(4) Boston Edison should update the Nuclear Energy Pamphlet to impress upon the public the importance of following official instructions. Necessary information should include maps, location of public shelters, locations of public transportation facilities, Emergency Broadcast System affiliates, traffic routes, reception areas and personal safety precautions.

EMERGENCY PLANNING ZONE (EPZ):

(1) Clarify that when any part of a town lies within an EPZ, the entire town shall be part of the EPZ. Planning and resources for these towns will have to be upgraded.

(2) Clarify planning for regional schools which have students from at least one, but not all, towns in the school system which are part of an EPZ.

(3) Clarify authority of Public Safety to plan for a radiological emergency beyond a 10 mile EPZ. (See Recommendation I — Division of Nuclear Facility Safety)

(4) Evacuation time estimates and traffic control plans should be based on evacuations of people within the EPZ to centers well beyond the 10 mile zone and should anticipate secondary or shadow evacuations.

STATE PLANNING:

(1) Increase state assistance to local planners. This should include technical assistance as well as financial assistance for local use. The goal should be coordinated regional planning as well as strengthened local plans.

(2) Inventory and where necessary create adequate local shelters to protect non-resident visitors in the event of emergencies which may not require evacuation.

(3) Identify area medical services, hospitals and medical personnel available for use outside of the EPZs. Also evaluate any additional services and supplies which may be necessary to serve EPZ population in the event of an emergency, including emergency treatment facilities and training of medical personnel.

(4) The state and towns should participate in appropriate emergency drills.

(5) Specific planning shall be developed for emergency notification, evacuation planning, and traffic control planning should be imposed in areas outside of an EPZ which pose unique problems, e.g.: Cape Code and the Islands.

(6) Inventory of available buses, ambulances and handicapped/ elderly vans, to assist in an evacuation. Develop an inventory of service stations and towing operations to be available along evacuation routes.

(7) Supervise planning by towns, ensure a coordinated, regional plan, and ensure cooperation between the utilities and area towns.

(8) Identify and designate adequate reception and decontamination centers and ensure the availability of adequate supplies and equipment.

(9) Ensure appropriate annual review and publication of plans working with the utilities, towns and Federal Emergency Management Agency (FEMA).

(10) Evaluate and where necessary correct effectiveness of notification and communication system between state and local officials.

(11) Identification, notification and workable evacuation plans for people in all institutional facilities — such as hospitals, nursing homes, schools and prisons — inside the EPZ.

(12) Contractual agreements for the above services where appropriate should be made to avoid any erroneous assumptions of transportation in the event of an evacuation.

LOCAL PLANNING:

(1) Each town in an EPZ should consider establishing a Radiological Emergency Response Plan Committee to review matters pertaining to emergency response planning.

(2) Local plans need more thorough documentation and letters of agreement between involved parties to ensure clear lines of responsibilities in the event of an emergency.

(3) Local officials should inventory local planning needs, equipment and resources which can be provided by the Division of Nuclear Facility Safety or the utilities.

(4) In addition to plans for their own communities, local officials should work closely with neighboring communities to ensure workable regional planning.

(5) Each town in an EPZ should establish plans for informing non-residents of procedures to be followed in the event of an emergency.

The state and utility have been ineffectual and too informal in developing adequate emergency response plans. The committee, therefore, finds:

A) The Pilgrim Nuclear Power Plant should not restart until, and unless, an emergency preparedness plan, including evacuation, has been approved by the Selectmen in the EPZ communities and by the Governor;

B) Federal, state, and local officials and the utility should coordinate actions in order to reach a decision on whether to approve emergency response plans prior to restart.

C) The cost of emergency planning should not be borne by all taxpayers, but financed through utility assessments.

Mr. FORMAN. I, frankly, don't see the problem with giving the States the power to decide whether or not they have nuclear power plants. I fully understand and accept the rationale that States and local governments shouldn't necessarily regulate nuclear power plants in monitoring them in terms of their operation as well as in terms of the conditions of health effects. But I have a problem with the federal government prohibiting States from deciding whether or not they want plants in their State.

I'm also troubled by the fact that the only straw that we seem to be grabbing at in trying to create some State authority is the use of emergency preparedness and withdrawal of State approval or denial of State approval for emergency plans. I think that actually could lead to some public safety risks, depending on how the court and the NRC interpret the State authority. So I would urge Congress and the administration to consider some outright approval to States across the country, not just because of Pilgrim, but in terms of State authority and Federal.

The CHAIRMAN. What do we do on nuclear waste? Do we give the States authority to reject that?

Mr. FORMAN. We keep the pressure on Congress and the administration to pick a site out in Nevada. [Laughter.]

The CHAIRMAN. Do we give those States the power to reject?

Mr. FORMAN. I don't think we can.

The CHAIRMAN. First of all, we might just make it normal procedure if a State is going to use nuclear power, let them take the risk in terms of storing it.

[Applause.]

Mr. FORMAN. If I can suggest something in response to that. We deal with issues in this State over low level waste, solid waste and we run into those siting problems. I think that you can clearly infer a distinction between the State's willingness or desire to have an operating plant sited in their State as opposed to national public health interest of finding a disposal site which is environmentally sound.

The CHAIRMAN. I think that's right.

Mr. ALEXANDER. I would say, first of all, that the legal issue of the State's problem is still up in the air. You know Governor Celeste of Ohio actually withdrew the Emergency Response Plan for nuclear powerplants there until the Commission could take another look at it, and that's in the court as to whether or not he has that authority or not.

So I would first say that it is still unclear whether Massachusetts can say, "Well, we're not going to allow Pilgrim to operate because we don't feel that the emergency response plan is adequate," but I do think it would be worthwhile to allow Congress to allow States the ability to regulate nuclear power to the extent that if Congress has a standard, that States should be allowed to have standards that are at least as tough as those of the Federal standards; that way you are not going to have people who might not be as expert weakening the standards. On the other hand, if the States should have proper standards, it should be allowed to do so.

The CHAIRMAN. Senator Golden, we very much acknowledge the very important contributions you have made in terms of raising so

many of these issues. I'm grateful for your presence here this evening.

Let me ask you, given what you have said about the evacuation plans, do you think it is possible to develop an effective evacuation plan at this point?

Mr. GOLDEN. I believe it would be very difficult, Senator, to develop an effective evacuation plan. I believe, given the limited transportation routes in this area, we've lost effectively 180 degrees because the plant is on the shoreline, and because of the limited north, south, east and west transportation access that we have to the site, I believe that if the plant was to restart, it would require significant sheltering plans with shelters that were properly equipped and those that could withstand the pressure and stress of the public's access to them. Right now, we don't have that. There are people who are being sheltered in 2-foot crawl spaces, according to the existing plan, and in buildings that don't exist any more. So we need a lot of input——

If I could just briefly respond, Senator, to your question about access to the public. I would like to see Congress change the Atomic Energy Act and permit the Governor of a State, as a matter of right, to demand a show cause petition. Our Governor has requested a show cause hearing. I believe each Governor of each State should have that right, at least, and that would open the public process. The public process could also be opened up, I believe, by enabling local government, as well as State government, a role in the formulation and implementation of these plans, and with that role, the veto power over the plants for their own communities because they do know their communities well.

The CHAIRMAN. Let me ask just quickly and then we can move on. You stressed in your statements you've made on this issue in other forums, the importance of development of cheap energy. Are your views tonight consistent with what you would like to see in terms of development of cheaper energy?

Mr. GOLDEN. Yes, Mr. Chairman. One form of cheap energy production is energy conservation. As Rachel Shimshak from MASSPIRG has indicated, this company, through its own committee, the Hogan committee, it was chaired and directed by the United States—former U.S. Senator Saunders, indicated this company by the year 2000 saved a thousand megawatts of power. The company in response would request a proposal, a proposal submitted in excess of 2,000 megawatts.

All of that power would provide, I believe, a cheap alternative to Pilgrim. Given the fact especially, Mr. Chairman, that since April of 1986, when this plant was shut down, there has been expenditures totaling over $300 million for replacement power and construction cost on this plant. That's $300 million, and we're not any better off today with all that expenditure than we were 20 months ago when the plant was shut down.

The CHAIRMAN. Just quickly, Mr. Alexander.

Mr. ALEXANDER. Thank you, Senator. Certainly the cheapest form of power is conservation—where we don't have to produce more power. An example of conservation's potential is the Appliance Efficiency Law that was passed here in Massachusetts. This one law alone—by only allowing stores to sell energy-efficient re-

frigerators—will each year by the year 2000 save us an amount of power equivalent to approximately half of the output of the Pilgrim nuclear power plant. One simple law will do that. The Federal appliance efficiency law is going to save the equivalent amount of energy as about 23 nuclear powerplants.

It also needs to be said that if you do need new sources of power, it makes much more sense to have in place small generating facilities that are relatively local, so that if one, for instance, has an outage, we don't all of a sudden face the kind of crisis that the New England power pool suggests we're going to have, when a couple of nuclear powerplants are down for total plant maintenance.

Mr. FORMAN. I have a slightly different view on the importance of conservation. Any sound energy policy obviously has to include conservation, but I think that we are somewhat misguided in assuming that in a region that is growing, an economy that is growing and dependent on energy, that we're going to survive for too long in the future simply by conserving. There is a finite limit on how much we can conserve and continue to grow.

Mr. ALEXANDER. I think one of the great problems we have in this country is that we don't have a national energy policy that anyone can identify, and from what I can tell, the State doesn't either. I don't know of any states that do have a policy, and that's a real problem. It doesn't have to be based on nuclear. Clearly, we can have energy policy without it, but both the State and the country, we need some sound energy policy that will go way beyond conservation and talks about generation of new power sources for growing areas, such as a fossil plant in Weymouth. [Applause.]

The CHAIRMAN. Thank you very much. I want to first of all thank you, and the people of Plymouth, through you, for all of their willingness and hospitality this evening and for helping us so much with this hearing.

I have just one point. As I understand your testimony, the Plymouth Board of Selectmen has made their objections known to the NRC concerning restarting of the plant without an adequate preparedness plan. I would like to ask you how the NRC has responded to your concern.

Mr. MALAGUTI. We have constant communication with the NRC. We had indications that they are receptive to our comments.

The CHAIRMAN. Did they say they wouldn't restart until they worked out the new evacuation plan?

Mr. MALAGUTI. No, sir. They have not.

The CHAIRMAN. Do you think they should?

Mr. MALAGUTI. Absolutely.

The CHAIRMAN. OK. Ms. Shimshak, we'll include all of the MASSPIRG studies in the record. The first is the 1983 report entitled "Blueprint for Chaos," and then there is the 1987 report entitled "No Exit," and finally there is the other 1987 report entitled "Nuclear Lemon." All those will be included.

[The documents referred to above follow:]

MASSPIRG

THE MASSACHUSETTS PUBLIC INTEREST RESEARCH GROUP

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Thank you all for your contributions to improving emergency preparedness at Pilgrim.

Michael Ernst
July 20, 1983

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EXECUTIVE SUMMARY

As a result of the partial core meltdown at Three Mile Island, the Nuclear Regulatory Commission (NRC) was forced to concede that dangerous quantities of radioactivity could escape from nuclear power reactors and that workable evacuation plans were necessary to protect the public. A government study estimated that a very serious meltdown at Pilgrim Nuclear Power Station in Plymouth, MA, could kill 3,000 people, injure 30,000 more, and cause 23,000 fatal cancers.

Effective emergency planning and preparedness can greatly reduce radiation exposure because some reactor meltdowns would take many hours to develop and provide ample time for evacuation. For faster developing meltdowns, proper sheltering with breathing filters and a drug to protect the thyroid glands would reduce the health consequences.

Unfortunately, more than two years after the NRC deadline, the Pilgrim emergency response plans remain woefully inadequate in violation of state and federal law. The Federal Emergency Management Agency (FEMA) has identified 73 deficiencies in the plans and emergency drills. MASSPIRG's research reveals additional problems so serious as to place the population in and near Plymouth and Cape Cod at extreme risk if a meltdown occurred.

Highlights of MASSPIRG findings:

* Evacuation planning only applies to a 10-mile radius around Plymouth, excluding Cape Cod, even though government studies estimate a serious meltdown could kill 3,000 people up to 20 miles from the reactor.

* Only two-thirds of the permanent residents and no tourists have received emergency information, which is incomplete, inaccurate and contradicts the official plans anyway.

* There are insufficient warning sirens that are not loud enough, and fully three-quarters of the area residents have heard false alarms.

* There are no workable plans for evacuating the physically disabled, nursing home residents, school children, hospital patients, campers, inmates or people without cars.

* Cape Cod will receive no early warning of a meltdown and the Cape bridges will be closed to prevent Cape traffic from interfering with evacuees from closer to the reactor.

* Sheltering, medical and evacuation reception facilities are grossly inadequate to care for the 120,000 summer residents and tourists (not counting the summer Cape population of 1/2 million).

MASSPIRG calls on the NRC to consider shutting down or reducing the operating power of Pilgrim until emergency preparedness is substantially upgraded. MASSPIRG also recommends that the Governor establish a public emergency planning commission with local representation to oversee the development of workable emergency plans.

EMERGENCY PLANNING: AN OVERVIEW

"Every man for himself!" According to the director of the Indian Head Campground, south of Plymouth, Massachusetts, that is the extent of the evacuation plan for as many as 1,000 campers there in case of a meltdown at the Pilgrim Nuclear Power Plant just seven miles north.[1] Unfortunately, that seems an apt characterization of the evacuation plans for all the physically disabled, elderly, nursing home residents, tourists, hospital patients, and those dependent on public transportation who are in the vicinity of Pilgrim Station. Even the Federal Emergency Management Agency (FEMA) acknowledges there are no fewer than 73 deficiencies in the emergency plans designed to protect the public in the event of a Pilgrim meltdown.[2] Taking into account Pilgrim's safety record, the need becomes urgent to develop and implement a practical evacuation plan. This study is intended as an evaluation of current emergency preparedness with recommendations for realistic ways to improve the current situation.

The Need for Emergency Planning

Under certain reactor accident scenarios, effective emergency response plans could save thousands of lives. Effective public evacuation or sheltering can reduce radiation exposure substantially. For slow-developing reactor core meltdowns, radiation would not escape into the atmosphere for 24 hours or more, providing ample time to evacuate downwind areas.[3] Even for meltdowns that develop more quickly, it is essential to alert people

immediately so they can take shelter before the radioactive cloud reaches them.[4] Like the President's Commission on Three Mile Island, the Nuclear Regulatory Commission's own Special Inquiry Group, commissioned to investigate that accident, concluded that "workable evacuation plans" should be a "prerequisite to continued operation of existing and future reactors." [5] Major improvements in these plans were recommended by both investigations.[6]

Emergency preparedness is crucial because even though the likelihood of a meltdown is not great, the consequences of a serious radiation release are horrendous: the government now estimates that a "worst-case accident" [7] at Pilgrim could kill 3,000 people within a year, injure 30,000 more, and cause 23,000 fatal cancers.[8] Total damages could exceed $80 billion, not including medical expenses. Even a minute chance of such an accident is cause for concern in light of its potential severity. The NRC discovered that the Three Mile Island reactor was "within 30 to 60 minutes" of a major core meltdown with "potentially serious public health and safety consequences." [9] A Nuclear Regulatory Commission (NRC) report released last summer evaluated almost 20,000 "mishaps" at nuclear power reactors from 1969 to 1979 and concluded that accidents as serious as that at Three Mile Island were likely to occur once every three to eight years somewhere in the country.[10] Directly after the Three Mile Island accident, in fact, the President's Commission convened to study the matter and made about 100 recommendations. Its report concluded that even the adoption of these "<u>necessary</u> fundamental changes" could not assure the safety of

nuclear power.[11] In fact, only a handful of these "necessary" changes were ever adopted by the NRC.

If nuclear power in general is cause for concern, the safety record of the Pilgrim plant in particular is positively alarming. Of the 54 most serious "meltdown precursors" at nuclear plants nationwide during the last decade, four occurred at Pilgrim.[12] The Plymouth plant averaged one mishap a week during 1981 and was rated "below average" by the NRC in overall management and in reactor safety performance.[13] Boston Edison, which owns and runs the facility, was fined $550,000 in early 1982 — the largest fine ever collected from an American nuclear power plant operator — for disconnecting a major safety system for 2½ years and then making a "material false statement" about it.[14]

Emergency Planning in Massachusetts

The Nuclear Regulatory Commission's Special Inquiry Group on Three Mile Island discovered that the NRC, because of a "prevailing attitude that a serious accident with releases beyond containment simply would not happen,"[15] had not taken seriously its authority over emergency planning. Both the Special Inquiry Group and the President's Commission on Three Mile Island recommended preparedness around nuclear plants should be transferred from the NRC to the Federal Emergency Management Agency (FEMA).[16] While retaining final authority over the emergency plans, NRC

did issue new regulations in 1980 that require FEMA to review and comment on all state and local plans.[17] Workable plans were supposed to be in place by April 1, 1981.[18] The regulations require FEMA and the NRC to determine whether plans "adequately protect the public health and safety by providing reasonable assurance that appropriate protective measures can and will be taken in the event of a radiological emergency."[19]

Yet even if NRC ultimately determines that a given set of plans are inadequate, the reactor would be permitted to continue operating provided the utility could show that any deficiencies were "not significant," that "compensating actions have been or will be taken promptly," or that "other compelling reasons" exist to permit plant operation.[20] Indeed, the NRC has already used this escape clause to permit the continued operation of the Indian Point reactors in New York. Despite FEMA findings that the emergency plans for Indian Point still contained significant deficiencies more than two years beyond the deadline, the NRC refused to take any enforcement action.[21] NRC Commissioner Asselstine charged the decision "made a mockery" of the NRC's regulations.

The burden of drawing up emergency plans in the Commonwealth falls to the Massachusetts Civil Defense Agency. In the event of a serious accident at Pilgrim, Boston Edison's reactor operators are to notify state police while taking steps to prevent a radioactive release. The state police in turn notify the Department of Public Health (DPH),

state and local civil defense officials and local town selectmen. DPH has primary responsibility for determining the extent of danger presented to the public and recommending protective actions. Radiation information is obtained directly from the utility and from independent evaluation teams in the field. These "Nuclear Incident Advisory Teams" from Boston collect air samples downwind from the reactor and perform radiation analyses. On the basis of this information, the DPH recommends a course of action to the Governor. Evacuation may be ordered by the Governor, the Commissioner of Public Health, the state director of civil defense, or by the local Board of Selectmen. The Civil Defense Agency actually conducts the evacuation. (The plan, of course, contains further specifications regarding the notification of the public and evacuation procedures, and it is these details with which the present report is particularly concerned.)

The attempt by Boston Edison and state civil defense to develop a comprehensive emergency response plan, however, was doomed from the start by the failure to include local communities in the planning process. Only long-term residents have a complete understanding of local resources, capabilities, needs and even likely evacuation obstacles. As a result, carefully planned "emergency" drills may demonstrate the ability of emergency officials to communicate with each other, but they do not indicate whether 100,000 local people could be notified, mobilized and evacuated in case of a real emergency.

In 1977, MASSPIRG published a report evaluating emergency plans for nuclear reactors in Massachusetts. The report, entitled "Nuclear Evacuation Planning: Blueprint for Chaos," concluded that planning was "shoddy and a reactor accident would place citizens' safety in jeopardy." Six years later, we are forced to reach the same conclusion.

A careful review of the current emergency plans reveals major problems with every section. In September of 1982, FEMA found 73 deficiencies.[22] Not only do the plans fall short of FEMA's basic standards, but they seem sloppily concieved and incapable of implementation. The result, we fear could be tragedy on a mass scale. The plan is analyzed in four chapters, as follows: first, The Emergency Planning Zone size is evaluated to determine whether the plan is designed to protect all the residents who actually would be affected by an accident; second, we examine the procedure for informing residents in advance about what to do in case of an accident at Pilgrim; third, the emergency warning system, intended to inform residents at the time of an accident, is evaluated; and finally, we examine the actual evacuation and sheltering plans and other procedures for protecting the populace. Specific recommendations for improving the emergency plan are offered after each section.

I. THE EMERGENCY PLANNING ZONE

The first consideration in regard to planning for a nuclear power plant accident is the size of the area involved. This is known as the Emergency Planning Zone (EPZ), and it obviously should be large enough to include virtually all people who would likely be exposed to significant doses of radiation in case of a reactor malfunction. In fact, though, current plans limit the EPZ to areas within 10 miles of Pilgrim. This is a consequence of both NRC guidelines and a determination by Boston Edison and the Civil Defense Agency. In any case, it proves on inspection to be absurdly inadequate, with the result that thousands of people who might suffer from a nuclear accident are utterly without protection in the emergency plans. ...

The NRC has decided that EPZ's should be about 10 miles in radius, with site-specific adjustments based on local "demography, topography, land characteristics, access routes, and jurisdictional boundaries."[1] The effect of these additional criteria is considered below, but it should first be noted that even as a rough guideline, a 10-mile EPZ is wholly inadequate. Several lines of analysis lead to this conclusion:

* The NRC's own rationale is that 70% of core meltdowns would not result in harmful doses of radiation beyond 10 miles for a typical reactor.[2] By its own estimate, then, the suggested EPZ would be inadequate for nearly a third of all major accidents. Of this group, two-thirds will result in harmful doses out to 20 miles, and the remainder to between 40 and 50 miles.[3]

* A recent government study determined that a worst-case accident at Pilgrim could kill people as far as 20 miles from the reactor and cause injuries 65 miles away.[4] (Boston city limits are less than 35 miles from the plant.)

* If adequate EPZ size is best judged under actual accident conditions, it is useful to recall that the NRC ordered evacuation plans developed for those living within 20 miles of Three Mile Island.[5]

* California took seriously the hazards presented by major melt-downs and established EPZ boundaries ranging from 18 - 35 miles from the reactor.[6]

The NRC 10-mile EPZ is based on an outdated accident probability study,[7] and is proposed with the suggestion that more serious accidents could be handled on an "ad hoc basis."[8] (Thus, the varied and complicated information needed to effect an evacuation, much of which is not even available for the 10-mile EPZ after three years of planning, is supposed to be collected in a matter of hours.) Yet even the woeful inadequacy of these guidelines is somewhat mitigated by the criteria offered for site-specific adjustments, listed above. Unhappily, all of these criteria but one have been ignored in designating a 10-mile EPZ for Pilgrim. Only the jurisdictional boundaries of area towns were considered;[9] the high population density of the area, particularly during the summer, was not a factor. Neither were topography, land characteristics, or access routes. People outside the designated EPZ are very likely to evacuate even if not required to do so: 2,500 women and young children were ordered to leave the Three

Mile Island area, but 144,000 actually left.[10] Planning must account for this *de facto* evacuation and the question of access routes becomes particularly critical. The only expressway in the area, Route 3, is already jammed on summer weekends, and the only exits off Cape Cod are two bridges less than 15 miles from the reactor. Incredibly, the Civil Defense Agency has decided that if the wind is blowing south when a serious accident occurs, the Cape bridges are to be closed.[11] If residents just outside the 10-mile EPZ are not included in emergency planning, they will not receive information on where and how to evacuate or whether to take shelter instead of evacuating. Limiting the size of the EPZ without consideration to the certain evacuation of those outside it therefore results in creating greater danger for residents both inside and outside of the zone.

Recommendations:

A site-specific analysis of accident probabilities and consequences of radioactive releases and of the probable health effects at various distances from the plant should be undertaken promptly. Civil Defense should hire independent consultants for this purpose, with Boston Edison paying all attendant costs. The ultimate objective should be to establish an emergency planning zone including Cape Cod that covers all persons at risk of receiving harmful doses of radiation from major core meltdowns.[12]

II. ADVANCE INFORMATION TO THE PUBLIC

No plan for a nuclear accident can hope to save lives if residents know nothing of its provisions until the accident occurs. Common sense dictates that the public must be familiar with evacuation and sheltering procedures before a major crisis develops, as well as the relative benefits of these two responses. There is evidence that many people will evacuate before directed to do so, and many others will not evacuate even when ordered to leave.[1]

Recognizing the importance of advance public information for emergency preparedness, FEMA and NRC developed several criteria to promote maximum public education on protective actions. Specifically, the federal criteria require provision of information on nuclear radiation hazards, protective measures including evacuation routes, sheltering, respiratory protection, radioprotective drugs, special needs of tourists and the physically disabled, and where to get additional information.[2]

Adequate dissemination of information involves using several methods rather than just one. FEMA and NRC recommend including emergency information in the phone book and with utility bills, as well as posting notices in public areas.[3] New York's public education program includes public service announcements on the radio, newspaper advertisements, and a speakers' program, while the EPZ for Vermont's Yankee nuclear plant contains large orange posters. In the Plymouth area, by contrast, a pair of emergency pamphlets is the only method for informing the public about a nuclear

emergency. Beyond the general inadequacy of this situation, some 45,000 tourists who are in the area each summer weekend and 24,000 seasonal residents are utterly without information.[4] FEMA considers this glaring omission a "significant deficiency."[5] The Chamber of Commerce has opposed any efforts to educate the tourists for fear of scaring them away.[6]

Even if the two pamphlets, prepared by the DPH and Civil Defense Agency, were universally distributed and exemplary, they would be insufficient to educate the public. In fact, though, they are neither. The two publications -- "Emergency Public Information," with evacuation and sheltering instructions, and "Nuclear Energy -- Questions and Answers," with more general information on radiation -- were supposedly mailed to all households in the EPA in the fall of 1982. MASSPIRG's telephone survey of 100 area residents, however, discovered that only 2/3 of the respondents had ever received the pamphlets and just 1/6 still had them available.[7] Emergency authorities have made no effort to ascertain how many pamphlets were received or how little their contents were understood. Only 9% of the respondents knew they should tune in their radio or TV to an Emergency Broadcast system station when they heard the Pilgrim warning siren.[8]

As regards the contents of the brochures, serious deficiencies exist:

(1) The educational information on radiation in the "Nuclear Energy" pamphlet does not convey the real danger of serious meltdowns.


OFFICIAL
CAPE COD
"MELTDOWN"
TOURIST CENTER
ground ZERO
NUCLEAR FREEZE
OFFICIAL EVACUATION MAP
MELTDOWN '83
MAKE IT OUT OF MASSACHUSETTS
SURVIVED THE MELTDOWN OF '83
SUMMER READING
TMI
COPPERADO TAN

The probability estimates of meltdowns from the outdated 1975 Reactor Safety Study are called the "best available." [9] The pamphlet also understates the hazards of radiation releases from reactors. The effect is to reinforce the inclination of many people to ignore evacuation orders. Less than 1/3 of the survey respondents realized that radiation released from a major meltdown could cause death.[10] If ordered to evacuate, 7% (nearly 4,000 people) would not leave.[11]

(2) The Plymouth Town Plan stipulates that "most residents of nursing homes will be evacuated by private automobile," but the "Emergency" Pamphlet specifically warns that people should not pick up nursing home residents because transportation will be provided for them.[12]

(3) While the Plymouth Town Plan includes 13 "staging areas" where "persons without transportation will be directed for possible public transport,"[13] the Emergency Pamphlet makes no mention of their existence or locations.

(4) Sheltering instructions (found only in the Nuclear Energy Pamphlet) provide no directions to public shelters for tourists or residents without basements. There are no instructions on ad hoc respiratory protection from contaminated air.

(5) Regarding evacuation of the physically disabled, the pamphlet simply states: "The disabled and those requiring special assistance

should contact the (local civil defense) offices listed below so that adequate preparation can be made and assistance provided. Do not call during an emergency unless absolutely necessary." There is no elaboration on evacuation procedures for the disabled. The MASSPIRG survey revealed that no one had called the Plymouth Civil Defense to arrange for evacuation assistance yet.[14] That means when an accident happens, everyone needing transportation assistance will be trying to call the civil defense office at the same time everyone else in town is trying to call there to find out what's going on. With everyone calling the office, very few will get through (phone lines to the police are already tied up whenever the sirens go off accidentally [15]).

(6) Four of the five telephone numbers listed for "local civil defense offices" do not reach these offices and none reach the local civil defense director.[16] The phone number listed for Carver Civil Defense is the number for reporting burglaries at the police station, and the first forwarding number provided for the civil defense director turned out to be a wrong number![17] The failure to update phone numbers in the plan quarterly was considered a "significant deficiency" by FEMA.[18]

(7) The state plan directs that "the special needs of persons within the EPZ who are ... non-English speaking" will be addressed.[19]

This is especially important in North Plymouth and other neighborhoods in the areas which contain large Italian and Portugese communities. The Emergency pamphlet, however, is published only in English.

Recommendations:

1) The Nuclear Energy Pamphlet should be updated with the latest federal estimates of the probability and consequences of serious meltdowns to impress upon the public the importance of following official instructions during an emergency.

2) The State and Town Plans and the Emergency Pamphlet must be updated to provide realistic and consistent emergency response plans.

3) The location of "staging areas" for public transportation must be included on maps in all emergency information materials.

4) The location of public shelters must be included on maps in all emergency information materials.

5) A confidential list of all physically disabled persons in the EPZ should be compiled by civil defense officials, and practical plans for their evacuation should be developed. Practical plans for evacuating the physically disabled, school children, nursing home residents, hospital patients, campers, institutionalized persons and people without 24-hour access to cars should all be clearly spelled out in all emergency information materials.

6) The correct telephone numbers for the local civil defense offices or directors should be included in all emergency information materials.

7) A comprehensive public education program including radio and TV public service announcements and a speaker's bureau to educate all residents of the EPZ should be implemented to supplement the pamphlet. This program should include an evaluation component to confirm that the public is being adequately informed.

8) A program must be developed for providing emergency information to tourists through distribution of Emergency Pamphlets, large posters, and telephone book inserts to all "hotels, motels, gasoline stations,"[20] restaurants and other public facilities in the EPZ.

9) Emergency information materials should be distributed in Portuguese, Italian and Japanese.

III. NOTIFICATION DURING AN ACCIDENT

Assuming all the people in the EPZ were provided with sufficient information so that they were prepared to react properly in an emergency, it would still be necessary to provide immediate and comprehensive notification as soon as trouble was detected. Federal authorities estimate that a nuclear accident could release substantial amounts of radioactivity as early as 30 minutes after the "initiating" event.[1] Once again, people living in the vicinity of the Pilgrim plant are endangered due to inadequate planning.

Notifying Authorities

Under current plans, the scheduled chain of emergency responses is begun by Boston Edison's reactor operators. The very organization with the greatest investment in convincing people that nuclear power is safe, in other words, has the discretion to decide when (or whether) to tell the state police that something has gone wrong. An incentive exists for Edison's reactor operators to delay reporting until they can correct the malfunction and then report that everything is under control. Indeed, within the past year alone, the NRC discovered three notification violations for Boston Edison's failure to provide prompt notification of problems which developed during reactor operation.[2] While two NRC

inspectors are assigned to oversee operations at Pilgrim, they are on duty for only about half of the operating hours.

Notifying the Public: Sirens

The NRC now requires a system capable of notifying the public in the EPZ within 15 minutes[3] -- a requirement curiously interpreted by FEMA to refer only to people living within five miles of the site, with those in the rest of the EPZ to be notified within 45 minutes.[4] In fact, the current siren warning system in and around Plymouth meets neither of these specifications. This is demonstrated, first, by admissions from the system's designers, and second, by results from a siren test.

Stone & Webster Engineering Corporation designed the fixed siren alert system to reach about 90% of EPZ residents and 98% of those living within five miles. The company recommended installation of 250 tone-activated Emergency Broadcast System (EBS) alarms to make sure the remaining people within five miles were notified and to provide back-up notification for "schools, hospitals, nursing homes, police and fire departments, and possibly for some hotel/motel offices." Even if these EBS receivers were provided -- and they have not been -- the engineering firm admits that some people living between five and ten miles from the reactor would not hear a siren.[5] In effect, the very design of the siren system now in use fails to meet federal requirements.

On June 19, 1982, the whole siren system was tested. Almost half (47%) of the FEMA observers reported the sirens were "inaudible" or "barely audible."[6] The sirens "did not generally wake people that were asleep," and between seven and nine of the 90 sirens did not work at all.[7] Noting, moreover, that the test was conducted on a warm summer day, the observers determined there was a "strong possibility that a significant portion of households within the EPZ would not be alerted by the fixed siren signal under adverse conditions" with windows and doors closed.[8] Their suspicions were confirmed by nearly half of the MASSPIRG survey respondents for both offices and homes.[9] FEMA concluded that "fixed sirens <u>alone</u> will not insure the necessary coverage."[10] After a similar evaluation at Indian Point, the utilities there agreed to install an additional 17 sirens.[11]

In addition, the observers reported several unsolicited complaints from residents that the sirens were often activating accidentally.[12] The MASSPIRG survey found that 77% of respondents had heard unplanned sirens. Two-thirds of these people had heard at least three and 15% heard more than 7 false alarms![13] FEMA stated that accidental activation of sirens reduces their credibility, "causing some residents to disregard the alerting signal."[14] This assertion was also corroborated by the MASSPIRG survey: 19% of respondents said if they heard the siren again, they would assume it was accidentally activated and ignore it.[15] We also were asked the following question: "Why can't they improve the sirens so people would believe them?"[16]

"Why can't they improve the sirens so people would believe them?" [16]

To determine whether a siren was a false alarm, nearly one-third of those surveyed said they would telephone someone -- usually the police or fire department. The fact that no one will be able to get a call through has already been demonstrated. The superintendent of the state prison in Plymouth complained that even he could never find out what was going on. "The sirens are always going off. The inmates and staff panic and I don't know what to do -- so I call the police but I can never get through." [17]

Finally, back-up vehicles with loudspeakers are supposed to go out and alert all areas where the sirens don't work. Unfortunately, there is no plan for discovering which sirens don't work.

Overall, FEMA concluded the siren system did not meet "minimum federal standards." [18]

Notifying the Public: EBS

Federal guidelines also call for civil defense officials to notify Emergency Broadcast System (EBS) stations in the event of a serious accident.[19] Anyone watching television or listening to the radio would be instructed to turn to an EBS station which, in turn, would provide emergency instructions. On June 3, 1982, an accident occurred that was classified as serious enough to warrant notification of EBS stations, but this did not happen.

Rumors about the severity of the accident spread as a result, and many citizens were understandably upset.[20] Even during the official emergency drill last year, officials failed to notify one of the EBS stations.[21]

Notifying the Deaf

According to the Massachusetts Office of the Deaf, 39,000 people in the Commonwealth are totally deaf and another 335,000 have serious hearing deficiencies. Of the 80,000 residents in the Pilgrim EPZ, there are probably at least one hundred deaf people and another thousand who would be unable to hear the warning sirens, let alone radio announcements or telephone warnings.[22]

Federal regulations require notification of "all segments" of the population,[23] and the state plan directs that "TV overprinting will be provided for hearing-impaired persons on area EBS television broadcasts during an emergency." [24] But what of those people in the target group who do not happen to be watching television when an accident occurs? Local officials are to maintain "confidential listings of households and individuals requiring assistance due to special needs." [25] No such lists have been compiled, and no plan exists to notify the hearing-impaired promptly in case of emergency.

Recommendations:

1) 'NRC inspectors should be on duty in the reactor control room 24 hours a day to insure the immediate notification of emergency officials whenever problems develop.

2) Enough sirens should be installed so that tests confirm 100% coverage of the EPZ with windows closed.

3) Alarms should be installed in every non-residential building in the EPZ, with a procedure developed to confirm that the sirens are in working order.

4) A system for determining promptly whether every siren is functioning must be implemented.

5) Civil defense officials should determine the number of vehicles with loudspeakers necessary to alert residents of any area within 45 minutes in case a siren fails.

6) Boston Edison should provide a teletypewriter for every deaf person in the EPZ.[26]

7) Capability for TV overprinting for hearing impaired tourists and seasonal residents must be available on a 24-hour basis.

IV. EVACUATION PLANS, SHELTERING, AND OTHER PREPARATIONS

The Decision to Evacuate

In the event of an appreciable release of radiation, officials must decide promptly whether to order evacuation or sheltering of the public downwind from the reactor. Evacuation is the preferred protective action because it prevents any radioactive exposure. Since cars provide very little shielding against radiation, however, sheltering in basements or large buildings provides greater protection from radiation exposure if there were insufficient time to evacuate before the radioactive cloud passed through the area.

If an order to evacuate is given with insufficient time to clear the area, thousands of people could be trapped in bumper-to-bumper traffic and irradiated as they are overtaken by the radioactive cloud. Before ordering an evacuation, emergency officials must be reasonably confident that the time necessary to evacuate an area is shorter than the time it will take for the radiation to escape from the reactor and blow through that same area.

The decision to order evacuation or sheltering, therefore, depends on three key estimates: the timing of a release of radioactivity from the reactor, the direction and velocity of the radioactive cloud after release, and the amount of time required to evacuate the area.[1] Unfortunately, the weather bureau's prediction of wind velocity and direction

over the next several hours is likely to be more reliable than the other two estimates. Emergency officials must rely on Boston Edison's reactor operators to give an accurate estimate of the time of release. Major accidents can result in releases of radioactivity into the air as early as half an hour or as late as a day or more after the accident begins.[2] Depending on the particular accident scenario, guessing when a significant release of radiation may occur could be a very speculative task.

The estimates of the amount of time necessary to evacuate downwind areas, while also speculative, are the only estimates that can be predicted even roughly in advance of an accident. Boston Edison hired transportation consultants, HMM Associates, to develop evacuation time estimates through the use of a sophisticated computer code. Their results, however, are based on completely unrealistic assumptions and seriously underestimate the time that would actually be required to evacuate each sector.

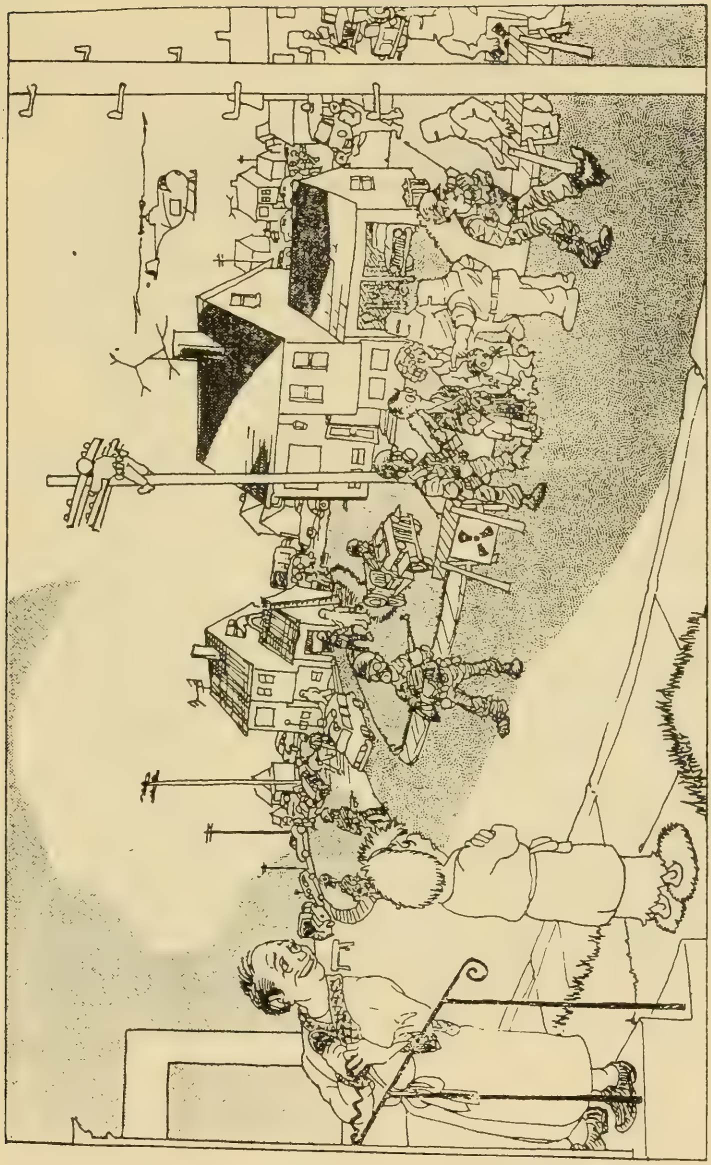
More specifically, they ignored the fact that obstacles to heavy traffic flow outside the evacuation zones will impair prompt evacuation inside the areas ordered to evacuate, that many people outside designated evacuation zones will also evacuate, that some drivers will panic and create traffic disorder, that thousands of residents do not have 24-hour access to a car and will need public transportation, and that different types of adverse weather and evacuating at different times of the day and the week will also affect the time necessary to evacuate various areas.

HMM Associates estimated it would take 160 minutes to evacuate the 10-mile sector south of Pilgrim Station. NRC consultants conducted a separate analysis and produced an estimate of 410 minutes.[3] HMM Associates then updated its study to include a "critical bottleneck" in traffic at the Sagamore rotary, just one mile outside the EPZ, and concluded the correct time was 315 minutes.[4] A discrepancy of over an hour and a half still remains. One wonders how many other traffic factors -- jams on Routes 6 and 25, for example -- were not considered in one or both analyses.

HMM Associates also stubbornly refuses to acknowledge that people living outside the designated evacuation sectors are likely to leave. As noted earlier, 144,000 people evacuated from around Three Mile Island even though only 2,500 people were ordered to do so. This single piece of evidence is so compelling as to demand that evacuation estimates be reconsidered immediately. As one study put it:

> In planning for an evacuation from a nuclear disaster, it can therefore be projected that any order to evacuate will cause the departure of residents not only from a designated zone but also from its peripheries.[5]

The attendant traffic jams from this phenomenon would likely be so enormous that untold thousands would be in extreme danger, and this situation is exacerbated by the failure to educate those outside the EPZ about evacuation routes or procedures.



"Relax, Martha, Civil Defense says we're perfectly safe on this side of the street - we're more than 10 miles from the meltdown.'

Furthermore, neither the estimates by HMM Associates nor by the NRC allow for the possibility of panic and traffic disorder. Substantiating this commonsense concern was a 1980 report by transportation consultants for FEMA: "Experiences such as major snowfalls (even in regions accustomed to such types of weather) suggest that driver behavior deteriorates quite regularly under circumstances of 30- to 90-minute delays."[6] One could expect such behavior as blocking cross streets, disregarding traffic signals, driving in the left-hand lane against traffic, abandoning vehicles, and many accidents as a result, according to the study. In fact, it predicted a 50% reduction in traffic flow compared to disciplined traffic. With ineffective traffic control, evacuation estimates concerning the Seabrook plant should be doubled.[7] Yet those people preparing estimates on the time necessary to evacuate the Plymouth area -- the estimates that will form the basis of a life-and-death decision -- assume that normal traffic conditions will prevail.

Moreover, the estimates by HMM Associates fail to consider the time necessary to evacuate the nursing homes, schools, hospitals, campgrounds, physically disabled and people without 24-hour access to cars. In fact, MBTA buses will be called in from Boston.[8] No estimates have been developed for the time required to bring in sufficient buses at different times of the day, week, and year and under various weather conditions. Indeed, federal guidelines require not just one evacuation time estimate, but a variety of estimates for different times of the day and different weather conditions for each sector around the reactor.[9] Boston Edison's only

time estimates are for peak and typical population during normal and adverse weather, falling far short of the multiple federal requirements.[10] Because of these various deficiencies -- failure to account for panic, traffic disorder, public transportation - dependent individuals, and so forth -- the Mass. Attorney General also has concluded that the evacuation time estimates are inaccurate.[11]

Even if HMM Associates considers these new factors, the new time estimates will remain speculative. Given all the uncertainties involved, the decision to order evacuation should only be made when the best estimate for a radiation release exceeds the new evacuation time estimates by a substantial margin.

Recommendations:

1. Given the difficulty in predicting the time when radioactivity may be released from a meltdown, reactor operators and NRC inspectors should be trained to make accurate estimates under various accident scenarios. In the event of an actual meltdown, reactor operators and NRC inspectors should give emergency officials their best estimates together with an indication of the level of confidence they have in these estimates.

2. Boston Edison should pay for a new evacuation time study supervised by FEMA. The new study should assume that a substantial amount of spontaneous evacuation will occur around the periphery of designated evacuation zones, that traffic obstacles outside the EPZ such as the Sagamore rotary will affect the amount of time required to evacuate the EPZ, that some drivers will panic and cause traffic disorder and delays, and that a substantial segment of the population will require public transportation to evacuate. The new study must also include separate evacuation time estimates for various special population groups, for different adverse weather conditions and for various times of the day, week, and year.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Special Population Groups

While all residents are at risk as a result of irresponsible and inadequate evacuation time estimates, certain individuals are at an even greater disadvantage in case of emergency. The plans fail to address the needs of specific populations, including handicapped persons, nursing home residents, school children, hospital patients, and inmates as well as everyone dependent on public transportation.

Civil defense authorities have made the assumption that private automobiles can provide virtually all of the transportation required to evacuate the population.[12] In fact, this is false: about 13% of Plymouth households, representing over 4,000 residents, do not own a car.[13] Also, nearly half of Plymouth's workers have jobs outside the town.[14] Should an accident occur during a weekday, the plans state that these workers may not be permitted to return home to pick up their families.[15] Another 10,000 residents may therefore require transportation.

Current plans call for sending in MBTA and other area buses to pick up residents without access to automobiles.[16] There is no evidence that the MBTA or any private bus lines have ever been contacted about evacuation assistance. Beyond the fact that no written agreement exists to provide for this (as federal criteria require[17]), it would take about 350 buses to evacuate 14,000 people[18] -- and no one has any idea how long this would take or whether that many buses could be made available quickly. Relying on large fleets of local buses raises another problem: most bus drivers would evacuate their own families from danger zones before reporting to drive

an evacuation bus. Two surveys of bus drivers in New York confirm this conclusion, and the state of New York is committed to funding a "comprehensive study" of the mass transit evacuation problems.[19] Finally, the "staging areas" where people would be picked up by buses are not listed in the emergency information pamphlet.

While federal regulations require the development of plans for "protecting those persons whose mobility may be impaired," these persons, perhaps 1000, have not even been identified yet.[20] Although the Massachusetts Radiological Emergency Response Plan states that lists of the physically disabled and elderly will be maintained by civil defense officials,[21] the Plymouth Plan says this:

> Because it is not feasible to maintain current lists of handicapped individuals within the towns, an inventory of local transportation resources, both private and public, that would be called upon to assist any individuals having special needs due to handicaps or disabilities will be maintained by the Director of Civil Defense. In addition, local agencies that serve the handicapped will be called upon to assist in the event of an emergency.[22]

Even if this alternative were accepted as satisfactory, it proves utterly unrealistic in practice. The "local agencies" are not specified, to begin with. As for transportation resources, the MASSPIRG survey revealed that only one of the twelve ambulance and wheel chair transit companies listed in the plan has been contacted regarding participation in an evacuation effort. Only one company listed is within 20 miles of Plymouth, and it closed two years ago. Five of the six ambulance companies have no plans to assist

and are not prepared to handle radiation victims. Gilbert Garnett, owner of Bristol County Ambulance, said he would not send any ambulances in the event of a serious accident:

> "If they want ambulances, they'll have to come get them. No one on my staff will go anywhere near Plymouth if there is an accident at the nuclear plant." [23]

Of the three wheel chair transit companies listed in the State Plan, one is a duplicate listing and the second is for a company that has been out of business for four years.[24] FEMA's recent evaluation concluded that "no information is found (in the plans) that provides protection for the mobility impaired," calling this a "significant deficiency" in the plans.[25] Only one director of all the nursing homes, campgrounds, and correctional facilities listed in the plans has ever been contacted about evacuation plans,[26] and contradictory plans for evacuating hospitals and schools add to the confusion. Consider:

* There are five nursing homes in the Plymouth area alone which the Plymouth Plan states have a total capacity of 380 residents.[27] The Plymouth Plan calls for an evacuation of these residents by automobile,[28] but the EPZ brochure tells people not to pick up nursing home residents because transportation will be provided.[29] A MASSPIRG survey found that the actual capacity of these homes is about 430, that none had been contacted about a radiological emergency (one spokesperson assuming they would have to "call in the National Guard"), and that it was not clear whether the staff was to evacuate with residents.[30]

* Plans call for 80 to 85 school buses to evacuate students

When pressed to explain how all these different groups of people can be evacuated, a civil defense official simply replied, "The Governor will declare a state of emergency and we'll order buses in here."[37] But how many buses are needed? From where? How long will it take for the drivers to report and drive them to the EPZ? Where will they go when they get there? These are life and death questions that cannot wait to be answered correctly during the panic of a real crisis. They must be answered now so that all the kinks can be straightened out before a meltdown. Without these answers an informed order to evacuate cannot be made.

Recommendations:

1) A diligent effort must be made to identify all persons within the EPZ who may need transportation assistance in an evacuation due to physical disability.

2) Practical plans must be developed to provide prompt transportation for each individual needing assistance to evacuate.

3) Civil defense officials should meet with the administrators of all nursing homes, medical facilities, campgrounds and correctional facilities to develop workable evacuation plans for the residents and the staff and to identify specific transportation needs for each institution at various times of the day, week and year.

4) Civil defense officials should sit down with school administrators and the P.T.A. to develop workable student and teacher evacuation plans and establish criteria for determining when, if ever, it would be appropriate to send children home first to evacuate with their families.

5) Civil Defense should undertake a comprehensive study, financed by Boston Edison, of public transportation resources available at various times of the day, week and year. Written agreements should be reached with both transport companies and their bus drivers.

Reception Facilities

If any evacuation is ordered, TV and radio EBS broadcasts and the police will direct evacuees to designated "reception centers" outside the EPZ. Evacuees will be monitored for radiation and decontaminated (if necessary), re-united with family members, and assigned shelter and/or transportation.[43] There are numerous problems with the feasibility and safety of the proposed reception procedure.

The first and most glaring problem is the location of the reception centers. Two of the three centers are in exactly the same direction as the areas from which evacuees would be fleeing![44] If the wind were blowing northward during an accident, evacuees north of Pilgrim would be sent north to Hanover Mall, just 20 miles downwind from Pilgrim. Government figures, remember, estimate a "worst-case" accident could cause deaths 20 miles downwind from the plant. Bridgewater State College has the same problem since it is located 20 miles due west of Pilgrim. Taunton State Hospital, the reception center for southern evacuees would also be within the radioactive plume if the wind were blowing southwest. If is unlikely in any case that most evacuees would stop just 20 miles downwind of a nuclear meltdown.

A summer evacuation would send roughly 40,000 people to any of these reception areas.[45] No one could seriously contend that any of these reception centers could handle that many people within the federal guideline of 12 hours.[46] During the March 3, 1982 drill, FEMA reported that Hanover officials "questioned whether water and sewage facilities were adequate for

potentially large numbers of people." [47] Hanover Mall does not even have adequate facilities for a few thousand people, let alone 40,000.

The State Plans provide for decontamination of evacuees and their vehicles.[48] Several decontamination washing solutions are recommended for a range of body and vehicle surfaces and degrees of contamination.[49] The plans caution that decontamination wash "drainage must be controlled." Current reception centers do not stock the recommended wash solutions, nor is there provision for control of contaminated drainage. FEMA criticized the lack of "soap, waste disposal, and contaminated clothing bags" at the centers.[50]

Recommendations:

1) New reception centers should be established at least 40 miles from Pilgrim, north and west of Boston.

2) These should be adequate to accommodate the entire permanent and transient population in the EPZ.

3) Each reception center should stock the full range of recommended wash solutions and have the capability of collecting contaminated wash drainage.

Medical Facilities

A core meltdown could result in a significant release of radioactive gases and particulate matter into the air. This can cause genetic mutations, cancer, serious injuries, and even death to all life forms. For this reason, federal regulations mandate the provision of special medical care for contaminated injured individuals.[51] The only two hospitals listed as providers of any medical care, however, admit they have the capacity to treat only 8 or 9 contaminated persons.[52] One of these hospitals, moreover, is only 3½ miles from the plant and obviously should not be utilized. The remaining hospital has no staff trained for radioactively contaminated patients.[53]

As a supplement to treatment at medical facilities — but by no means a substitute — potassium iodide (KI) has been proven safe and effective against radioactive iodine as a means of preventing thyroid tumors.[54] Laboratory workers exposed to radioactive iodine have taken KI for many years and FEMA guidelines now call for the use of KI in the event of a nuclear accident.[55] It is distributed by the Tennesse Valley Authority to households near the Sequoyah reactor and throughout all EPZ's in Sweden. National public interest organizations including the Union of Concerned Scientists and the Health Research Group support the distribution of KI to all dwellings in the EPZ and it's availability for sale over-the-counter for summer residents and those just outside the EPZ.[56]

Recommendations:

1) Sufficient medical facilities outside the EPZ should be ide to care for large numbers of contaminated individuals.

2) All emergency personnel should receive special training in treatment of radiation victims.

3) Potassium iodide should be distributed in childproof contai to every household in the EPZ before a nuclear accident. Instr should be included and the substance should be sold over-the-co as well.

Sheltering

If there is inadequate time to evacuate the public before of radiation passes through an area, the recommended protective sheltering.[57] As the cloud blows downwind, some of the radioac material or "fallout" is deposited on the ground and buildings If a substantial amount of fallout were deposited by the radioa cloud, then evacuation would be ordered as soon as the cloud pa order to minimize additional radiation exposure.

An effective sheltering strategy requires both protection gamma radiation emitted from the passing radioactive cloud and fallout as well as protection against inhalation of airborne rad particles. The basements of large buildings and of brick homes most protection from gamma radiation.[58] But where are 45,000 su tourists going to find basements in large buildings or brick hom

Wooden motels and cabins and tents provide virtually no sheltering protection from a radioactive cloud, and the 24,000 summer residents typically live in cottages that are also wooden and without basements.

In fact, even for the 54,000 full-time residents, there are few large buildings or brick homes with basements in the Pilgrim EPZ. Fewer than 20% of the permanent residences in Massachusetts are brick[60], and about 30% of the year-round homes in the EPZ have no basement.[61] Consequently, a substantial majority of the people in the EPZ lack adequate sheltering facilities.

Civil Defense has still not completed a survey of available public shelters in the EPZ. Those shelters identified already are not marked on evacuation maps as required by federal guidelines.[62]

This lack of sheltering protection is compounded by the failure to educate the public about simple building infiltration and breathing filter techniques. Sheltering studies have revealed that an average residence with windows and doors shut reduces the amount of radionuclides inhaled by about 35%. Greater protection is afforded by weatherstripping, storm windows and doors, and the taping of all window and door cracks in an emergency. Further protection would be provided by the use of individual respiratory filters such as hospital masks or wet towels or handkerchiefs.[63] The Emergency Public Information pamphlet, however, makes no mention of these important protective measures.

Recommendations:

1) Civil Defense should identify enough public shelters to accommodate as many as 80,000 people who lack basements in the summer.[64]

2) Public sheltering facilities should be equipped with necessities and clearly marked as Civil Defense shelters. Large signs should be erected directing tourists to the nearest shelters.

3) The location of public sheltering facilities should be clearly designated on the maps in the Emergency Public Information brochures, on large posters and in telephone book inserts distributed throughout the EPZ.

4) All emergency public information materials should include sheltering instructions, including techniques for making home-made breathing filters and reducing radioactive air infiltration into sheltering facilities or homes.

5) Civil Defense should distribute hospital masks to every building in the EPZ.[65]

Emergency Drills

No plans with the complexity of evacuation plans could ever be carried out successfully without regular and comprehensive drills. Every year, Boston Edison and state officials hold an emergency exercise simulating a meltdown at Pilgrim. The exercises expose important deficiencies which must be corrected, but they are still not sufficiently comprehensive to verify the capability to protect the public in the event of an actual meltdown.

At last year's drill, FEMA identified many deficiencies, including inoperable sirens, failure to activate an emergency broadcast system station, lack of equipment for measuring radiation, and the issuance of an incorrect evacuation order.[66] The federal evaluation of this year's drill, held June 29, will not be completed for several weeks, but Civil Defense and FEMA observers admitted there were significant communication problems at least.[67] The troubled siren system will not be tested until FEMA issues new evaluation criteria later this year.

A more serious problem is the failure of the exercises to demonstrate the capability to warn, mobilize, evacuate, and decontaminate the public. Even FEMA has conceded this point.[68] It is not necessary to attempt a full-scale public evacuation to establish this capability. At a minimum, however, all sirens should be tested, sample messages broadcast on EBS, special institutions alerted and transportation arranged for all special population groups needing assistance within the sector targeted for evacuation. This is an excellent occasion to educate the public through the media of the details of sheltering and evacuation.

Another problem with the exercises is the comprehensive prior planning and prenotification of emergency personnel. Federal criteria require occasional unannounced exercises during the evening and nighttime and under various weather conditions which more accurately test the real emergency response capability of officials.[69]

Recommendations:

1) Emergency exercises should include every aspect of an actual emergency response, except evacuation of the public. Every drill should include testing of all sirens, institutional alarms and back-up warning capability; activation of the EBS system and broadcast of simulated emergency messages, arrangements for transportation for all special population groups within the sector targeted for evacuation, and bringing in some buses from each participating bus company to report to a special institution or staging area and then to drive the evacuation route to the appropriate reception center.[70]

2) Drills should be conducted in the evening, at night, under various weather conditions and seasons, and without prior warning.

CONCLUSION

Individually, any of the problems with current emergency planning identified in this report is serious; collectively, they point to a crisis situation in extreme proportions. Even the Director of the Plymouth Civil Defense office, James Ryan, has admitted "there is no way that everyone can be evacuated." [1]

Besides the indefensible danger presented by the emergency plans, violations of state and federal law are involved.[2] The plans are required to provide "reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency." The Massachusetts Attorney General has agreed that the current plans fail to do this and has urged that consideration be given to the operation of Pilgrim at reduced power or even shut down during the summer, when the area is clogged with visitors whose lives are in jeopardy.[3]

MASSPIRG has submitted a formal petition to the Nuclear Regulatory Commission requesting immediate remedial measures, including consideration of shutting down Pilgrim until an adequate state of emergency preparedness is achieved.[4] Given the NRC's recent refusal to enforce emergency planning regulations under similar conditions at the Indian Point reactors in New York[5], though, it will no doubt fall to the Commonwealth to protect its citizens. MASSPIRG therefore urges the Governor to establish a public emergency planning commission to oversee the revision of these plans for Pilgrim (and for the area near the Rowe reactor, to the extent its problems are similar). The state also should commission an emergency mass transpor-

tation study, a new calculation of evacuation time estimates, and a computer analysis of the consequences of major meltdowns with an eye to expanding the emergency planning zone to include Cape Cod and other areas near the Plymouth plant. Until these recommendations are implemented -- until the egregious inadequacy of current planning is acknowledged and corrected -- the lives of thousands of citizens will remain at risk.

FOOTNOTES

OVERVIEW

1. MASSPIRG Survey of Major Campgrounds, Appendix B.

2. "Interim Findings: Joint State and Local Radiological Emergency Response Capabilities for the Pilgrim Nuclear Power Station" ("FEMA Interim Findings"), FEMA, September 1982.

3. "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," ("Planning Basis"), NUREG-0396, EPA/NRC, December 1978, p. 20. Also see Chapter IV: Evacuation Plans.

4. See Chapter IV: Sheltering.

5. "Three Mile Island: Report to the Commissioners and to the Public" ("NRC Special Inquiry Group Report"), NRC Special Inquiry Group, 1980, p. 132.

6. "Report of the President's Commission on the Accident at Three Mile Island" ("Report of the President's Commission"), October, 1979, pp. 76-77 (emphasis in original); NRC Special Inquiry Group Report, op. cit. pp. 131-133.

7. The NRC defines a "worst-case accident" as the worst accident considered theoretically possible at a nuclear power plant. It may be worth noting, however, that the accident at Three Mile Island was considered "not credible" - which is to say, impossible - before it actually happened.

8. "Calculation of Reactor Accident Consequences ("CRAC 2") For U.S. Nuclear Power Plants (Health Effects and Costs) Conditional on an SSTI Release," U.S. House of Representatives Committee on Interior and Insular Affairs, Subcommittee on Oversight and Investigations, November 1, 1982, p. 9.

9. NRC Special Inquiry Group Report, op. cit., p. 91.

10. "Precursors to Potential Severe Core Damage Accidents" ("Precursors"), NUREG/CR-2497, Oak Ridge National Laboratories, 1982.

11. Report of the President's Commission, op. cit., p.7.

12. "Precursors," op. cit.

13. "Systematic Assessment of Licensee Performance," NUREG-0834, 1981; NRC memo from Gus Lainas, Assistant Director for Safety Assessment, to Darrell Eisenhut, Director, Division of Licensing, "Summary of the Operating Reactor Events Meeting on December 16, 1981," December 28, 1981. (These safety rankings are based on both the number and severity of mishaps between December 13, 1980 and October 7, 1981.

14. Letter to F.M. Staszesky, President, Boston Edison Company from Richard C. DeYoung, Director, NRC office of Inspection and Enforcement, NRC Docket No. 50-293 (January 18, 1982).

15. NRC Special Inquiry Group Report, op. cit., p. 131.

16. Report of the President's Commission, op. cit., p. 76.

17. 10 CFR §50.47 and Part 50, Appendix E.

18. 10 CFR §50.54(s)(2)(i).

19. 44 CFR §350.5(b) (proposed rule; current FEMA guidelines); 10 CFR §50.47(a)(1).

20. 10 CFR §50.47(c)(1).

21. "In the Matter of Consolidated Edison Company of New York and Power Authority of the State of New York (Indian Point 2 & 3)", CLI-83-16, June 10, 1983.

22. "Interim Findings," op. cit., pp. 1,5.

I. THE EMERGENCY PLANNING ZONE

1. 10 CFR §50.47(c)(2); 44 CFR §350.7(b) (current guidelines).

2. Planning Basis, op. cit.; "Massachusetts Radiological Emergency Response Plan ("State Plan")," Appendix 3 - Pilgrim, pp. C-78-79. (The Environmental Protection Agency recommends evacuation when the expected radiation dose to the public is one "REM". A REM is a unit of measuring radiation exposure and is the equivalent of receiving about 10 x-rays.)

3. Planning Basis, op. cit.

4. "CRAC 2," op. cit.

5. Report of the President's Commission, op. cit., p. 40.

6. "Emergency Planning Zones for Serious Nuclear Power Plant Accidents," California Office of Emergency Services, November 1980.

7. The Planning Basis report, op. cit., was written in 1978 and used the probability estimates of the 1975 Reactor Safety Study. More recent studies indicate a higher probability of accidents (Precursors, op. cit.) and more serious consequences from them (CRAC 2, op. cit.).

8. "Planning Basis," op. cit., p. 16.

9. "Response of Boston Edison to Commonwealth of Massachusetts' First Set of Interrogatories on Emergency Planning, " July 20, 1981, p. 2.

10. "NRC Special Inquiry Group Report," op. cit., p. 1016.

11. "A Public Meeting on the State and Local Off-Site Radiological Emergency Plan," Transcript of Hearing. ("Transcript of Public Hearing"), Plymouth, Mass., June 3, 1982, statement by Paul Cahill, then Director, Mass. Civil Defense Agency, p. 109.

12. "Comments of Attorney General Francis X. Bellotti Relative to Off-Site Emergency Planning for the Pilgrim Nuclear Power Station," ("Comments of the Attorney General"), submitted to FEMA, August 1982, pp. 11-13.

II. ADVANCE INFORMATION TO THE PUBLIC

1. "The Social and Economic Effects of the Accident at Three Mile Island," C.B. Flynn and J.A. Chalmers, 1980, p. 22. (About 20,000 people evacuated from Three Mile Island before any order was issued.) On the other hand, the MASSPIRG Survey also revealed that 7% of respondents would not evacuate even if ordered to do so (Appendix A, #32). Twenty percent of respondents in the Shoreham EPZ said they would not evacuate. ("Discussion Overview of the RERP of the County of Suffolk," Philip B. Herr & Associates, Nov. 29, 1982, p. 15.)

2. Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants("Evaluation Criteria"), NUREG-0654, Rev. 1, Evaluation Criteria G.1.,G.2.

3. Evaluation Criterion G.1.

4. State Plan, op. cit., p. C-9.

5. FEMA Interim Findings, op. cit., p. 6.

6. Phone conversation with Gerald Hayes, former Plymouth Civil Defense Director, July 12, 1982.

7. MASSPIRG Survey of Residents, Appendix A, #23, #28.

8. MASSPIRG Survey of Residents, Appendix A, #16.

9. Nuclear Energy - Questions and Answers, p. 4.

10. MASSPIRG Survey of Residents, Appendix A, #43.

11. MASSPIRG Survey of Residents, Appendix A, #32

12. Town of Plymouth Radiological Emergency Response Plan ("Plymouth Plan"), p. 36. Emergency Public Information, p.6.

13. Plymouth Plan, op. cit., p. ANN. B-9.

14. MASSPIRG Survey of Local Civil Defense Directors, Appendix C.

15. MASSPIRG Survey of Correctional Facilities, Appendix D; Interim Findings, op. cit., pp. 15-16.

16. MASSPIRG Survey of Local Civil Defense Directors, Appendix C.

17. MASSPIRG Survey of Local Civil Defense Directors, Appendix C.

18. FEMA Interim Findings, op. cit., p. 6; Evaluation Criterion P.10.

19. State Plan, op. cit., p. C-21.

20. Evaluation Criterion G.2.

III. NOTIFICATION DURING AN ACCIDENT

1. "Planning Basis," op. cit., p. 20.

2. Letter from Richard Starostecki, Director, Division of Project and Resident Programs, NRC, to Boston Edison, dated September 28, 1982, Appendix A: Notice of Violation.

3. 10 CFR Part 50, Appendix E, IV. D.3.

4. Evaluation Criterion E.6. and NUREG-0654, Appendix 3, p. 3-3.

5. Report on the Coverage and Performance of Sirens Around the Pilgrim Nuclear Power Station ("HMM Siren Report"), HMM Associates, July 15, 1982, pp. 2-6 - 2-7.

6. Report on the Pilgrim Nuclear Power Station Siren Test, June 19, 1982 ("FEMA Siren Report"), FEMA, January 1983, p.6.

7. HMM Siren Report, op. cit., pp. 8-3, 4-7.

8. FEMA Siren Report, op. cit., pp. ii, 10.

9. MASSPIRG Survey of Residents, Appendix A, #7, #13.

10. FEMA Siren Report, op. cit., p. 11.

11. Letter from Lee Thomas, Acting Deputy Director, FEMA, to William Dircks, Executive Director for Operations, NRC, dated December 17, 1982.

12. FEMA Siren Report, op. cit., p. 9.

13. MASSPIRG Survey of Residents, Appendix A, #18, #19.

14. FEMA Siren Report, op. cit., p. 8.

15. MASSPIRG Survey of Residents, Appendix A, #16.

16. MASSPIRG Survey of Residents, Appendix A, #29.

17. MASSPIRG Survey of Correctional Facilities, Appendix D.

18. FEMA Interim Comments, op. cit., p. 15.

19. Evaluation Criteria E.5, E.6.

20. Transcript of Public Hearing, June 3, 1982, pp. 79-86.

21. FEMA Exercise Report, op. cit., p. 54.

22. 7% (39,000 deaf and 335,000 with serious hearing impairments out of 5,737,037 total residents) of Massachusetts residents have serious hearing deficiencies. Although deaf people tend to congregate in urban areas, it is reasonable to estimate that 2% (54,000 permanent residents in EPZ) or 1000 residents have serious hearing problems in the EPZ.

23. Criteria J.10.c, E.6.; 10 CFR Part 50, Appendix E, IV.D.3.

24. State Plan, op. cit., p. C-24.

25. State Plan, op. cit., p. C-24 - C-25.

26. Teletypwriters (TTY's) transmit typewriter messages over phone lines with warning lights that signal receipt of a message. In the past, Boston Edison offered to provide TTY's to deaf persons in the EPZ. California has provided TTY's to all deaf persons in the state.

IV. EVACUATION PLANS, SHELTERING, AND OTHER PREPARATIONS

1. Plymouth Plan, op. cit., pp. 5-6.

2. NUREG-0654, p. 17.

3. "An Evaluation of the Evacuation Time Estimates Submitted by the Applicant for a Peak Population Scenario at the Pilgrim II Nuclear Power Station," E.P. Moeller, T. Urbanik II, and A.E. Desrosiers, March 1981, p. 5.

4. State Plan, op. cit., p. C-86 (South 10 Miles - Normal Weather).

5. "Evacuation from a Nuclear Technological Disaster," D.J. Ziegler, S.D. Brunn and J.H. Johnson, Jr., The Geographical Review, January 1981, p.7.

6. "Seabrook Station Evacuation Analysis," ("Seabrook Analysis") Voorhuis and Associates, August 1980, p. 63.

7. Seabrook Analysis, p. 74; "Dynamic Evacuation Analyses: Independent Assessments of Evacuation Times from the Plume Exposure Pathway Emergency Planning Zones of Twelve Nuclear Power Stations," FEMA-REP-3, 1981, p. 46.

8. Exercise Report - Joint State and Local Radiological Emergency Response Exercise for the Pilgrim Nuclear Power Station, March 3, 1982 ("FEMA Exercise Report"), FEMA, September 1982, p. 45.

9. Evaluation Criteria J.8., J.10.1., and Appendix 4, pp. 4-3, 4-6, 4-7, 4-9, 4-10.

10. State Plan, op. cit., p. C-86.

11. "Comments of Attorney General Francis X. Bellotti Relative to Off-Site Emergency Planning for the Pilgrim Nuclear Power Station" ("Comments of the Attorney General"), submitted to FEMA, August 1982, pp. 7-9.

12. Plymouth Plan, op. cit., p. 8.

13. MASSPIRG Survey of Residents, Appendix A, #34.

14. Town of Plymouth Planning Board Survey, 1979; MASSPIRG Survey of Residents, Appendix A, #6.

15. Emergency Public Information Pamphlet, p. 6.

16. FEMA Exercise Report, op. cit., p. 45.

17. Evaluation Criteria A.3. and C.4.

18. To evacuate 14,000 people in buses with a capacity of 40 persons would require about 350 buses. Evacuation buses would not have room for much more than their capacity of 40 people because evacuees are directed to bring extra clothing and necessities. The civil defense estimate that only about 50 buses would be needed is clearly inadequate [FEMA Exercise Report, p. 45]. Civil defense also relies on carpooling too much [Plymouth Plan, p. 8]. There simply won't be that much extra room in the family car after the family, pets and clothing are stuffed into cars which are becoming smaller and smaller.

19. "Response of Emergency Personnel to a Possible Accident at the Shoreham Nuclear Power Plant," Social Data Analysis, Inc., October 1982; "Update Report on the Status of Remedial Actions Cited in the July 30, 1982 Interim Findings on the Adequacy of Radiological Emergency Response Preparation of State and Local Governments at the Indian Point Nuclear Power Station," ("Update Report on Indian Point,"), December 1982, p. 6.

20. Evaluation Criterion J.10.d; The MASSPIRG Survey of Residents discovered that 6% of households in the EPZ had physically disabled people. 6% of 20,000 households in the EPZ (1980 Census) is 1200 handicapped persons.

21. State Plan, op. cit., pp. 22-23.

22. Plymouth Plan, op. cit., pp. 39-40.

23. MASSPIRG Survey of Ambulance Services, Appendix E.

24. MASSPIRG Survey of Ambulance Services, Appendix E.

25. FEMA Interim Findings, op. cit., p. 6.

26. MASSPIRG Surveys of Nursing Homes (Appendix F), Campgrounds (Appendix B) and Correctional Facilities (Appendix D).

27. Plymouth Plan, op. cit., p. 38.

28. Plymouth Plan, op. cit., p. 36.

29. Emergency Public Information pamphlet, p. 6.

30. MASSPIRG Survey of Nursing Homes, Appendix F.

31. Conversation with Frank Willard, the Director of MCDA Area II Headquarters in Bridgewater, February, 1983.

32. Plymouth Plan, op. cit., p. 39; Emergency Public Information pamphlet, p. 6.

33. MASSPIRG Survey of Correctional Facilities, Appendix D.

34. FEMA Exercise Report, op. cit., p. 25.

35. Update Report on Indian Point, p. 6.

36. MASSPIRG Survey of Campgrounds, Appendix B.

37. Conversation with Frank Willard, Director of MCDA Area II Headquarters in Bridgewater, May, 1983.

38. Transcript of Public Hearing, June 3, 1982, Statement by Paul Cahill, former Director of the Mass. Civil Defense Agency, p. 109.

39. Conversation with Jane Peterson, Cape Cod Chamber of Commerce, February 8, 1983.

40. See Chapter I, supra, p. 7.

41. Warning sirens are only located within the 10-mile EPZ.

42. US Census, 1970 (basement data not collected in 1980 census).

43. State Plan, op. cit., pp. C-17 - C-19; Annex E, pp. C-101 - C-113.

44. State Plan, op. cit., p. C-17.

45. Total summer population of the EPZ is about 120,000, divided among 3 reception centers results in roughly 40,000 evacuees per reception center.

46. Evaluation Criterion J. 12.

47. FEMA Exercise Report, op. cit., p. 31.

48. State Plan, op. cit., Annex E, C-102 - C-103.

49. State Plan, op. cit., C-70 - C-72.

50. FEMA Interim Findings, op. cit., p. 9.

51. 10 CFR § 50.47(b)(12); 10 CFR Part 50, Appendix E, II.E and IV.E.7.

52. MASSPIRG Survey of Hospitals, Appendix G.

53. MASSPIRG Survey of Hospitals, Appendix G.

54. 43 Federal Register 58798, December 15, 1978.

55. Evaluation Criterion J.10.e. and J.10.f.

56. "Submission for the Record: Hearing on Potassium Iodide as a Thyroid Blocking Agent in a Radiation Emergency," Gordon Thompson, Ph.D., Union of Concerned Scientists, submitted to the U.S. House of Representatives Committee on Interior and Insular Affairs, Investigations and Oversight Subcommittee, March 5, 1982. The Mass. Department of Public Health opposes distribution of KI to the public. The advantages of KI far outweigh the disadvantages. None of DPH's arguments against use of KI override the protection that KI can provide from radiation exposure.

    The logistical problem of distributing KI after an accident has been solved by the Tennessee Valley Authority by simply distributing proper doses of the drug to residents within the EPZ before a meltdown occurs. The directions will indicate the dose and emergency officials will announce when to take the KI. Childproof caps would prevent unsupervised ingestion by kids.

    The side effects anticipated from the recommended dosage for radioprotection will be very minimal. Side effects occasionally appear after years of KI use at doses of 300 mg to 1200 mg per day. But for radiation protection, adults would take only 130 mg per day for 10 days, and kids just 65 mg per day.

    A few recent studies have suggested that anticipated releases of radioactive iodine during a reactor accident may be much lower than originally expected. The NRC, however, conducted a substantial investigation in 1981 that concluded that although the Reactor Safety Study may have overestimated the iodine that would be released from small accidents, the original estimates are probably still valid for the larger accidents. ["Technical Bases For Estimating Fission Product Behavior During LWR Accidents," NUREG-0772, June, 1981.]

    The last issue concerning KI is whether stockpiling the drug for distribution during an accident would be preferable to predistributing KI to all households in the EPZ. Attempting to distribute KI to all potentially affected households after an accident began would be a logistic nightmare if not physically impossible

57. Plymouth Plan, op. cit., pp. 5-6.

58. "Public Protection Strategies for Potential Nuclear Reactor Accidents: Sheltering Concepts with Existing Public and Private Structures," (SAND77-1725 D.C. Aldrich, D.M. Ericson, Jr., J.D. Johnson, Sandia Laboratories, 1978, p. 10.

59. Population figures are from the State Plan, op. cit., p. C-9.

60. SAND77-1725, p. 26.

61. 1970 Census Data (basement data not collected in 1980).

62. Evaluation Criterion J.10.a.

63. "Public Protection Strategies in the Event of a Nuclear Reactor Accident" (SAND77-1555) D.C. Aldrich, D.M. Ericson, Jr., Sandia Laboratories, 1978, pp. 40, 42-43.

64. There are 45,000 tourists on summer weekends. There are 24,000 seasonal residents of which close to 20,000 probably have no basement in their cottages. 30% of the 54,000 permanent residents don't have basements about 15,000 people.

65. 100,000 hospital masks for distribution in the EPZ would cost $19,090 from American Scientific Products, according to sales representative Mike Govern. (Contura Mask - 685-N)

66. FEMA's Interim Findings, op. cit., pp. 15,17,18; Exercise Report, op. cit., p. 54.

67. Conversation with Bob Archila, FEMA, July 13, 1983.

68. FEMA's Interim Findings, op. cit., p. 18.

69. Evaluation Criterion N.1.b.

70. Buses drive actual evacuation routes during drills for the Indian Point reactors, "Post Exercise Assessment (Indian Point)," FEMA, April 14, 1983. p. 14.

CONCLUSION

1. MASSPIRG Survey of Civil Defense Directors, Appendix C.

2. The failure to maintain adequate emergency response plans for a nuclear accident is a violation of the Mass. Civil Defense Agency's responsibility to protect the citizens of the Commonwealth. Mass. General Laws, Appendix to Chapter 33, Section 13. Federal law also requires workable plans: 10 CFR § 50.47(a)(1)(NRC) and 44 CFR § 350.5(b)(FEMA).

3. Comments of the Attorney General, op. cit., pp. 1, 14-15.

4. Petition of Massachusetts Public Interest Research Group for Emergency and Remedial Action, July 18, 1983.

5. "In the Matter of Consolidated Edison Company of New York and Power Authority of the State of New York (Indian Point 2 & 3)," CLI-83-16, June 10, 1983.

APPENDIX A

MASSPIRG Survey of Residents in the Emergency Planning Zone

MASSPIRG conducted a telephone survey of 100 residents of the Emergency Planning Zone (EPZ). The survey was designed and supervised by Martha Downey of Decision Research Corporation of Lexington, Mass. Respondents were selected at random from local telephone books for Plymouth, Duxbury, and Kingston. The number of respondents from each town was determined by the populations of each town so the results are applicable to the full EPZ, (Plymouth (pop. 35,913): 64 respondents, Duxbury (11,807): 22 respondents, and Kingston (7,362): 14 respondents). Half the respondents from each town were men and half women. MASSPIRG volunteers conducted the survey between February and May, 1983.

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
1. Local fire response capability?	Very Good	24	3	11	40
	Good	26	5	7	38
	Fair	2	0	0	2
	Poor	1	0	0	1
	Unsure	11	4	4	19
2. Quality of fire personnel and equipment?	Very Good	27	5	8	40
	Good	21	7	8	36
	Fair	4	0	0	4
	Poor	0	0	0	0
	Unsure	12	2	6	20
3. Ambulance response capability?	Very Good	21	5	14	40
	Good	22	5	3	30
	Fair	4	1	0	5
	Poor	1	0	0	1
	Unsure	16	3	5	24
4. Quality of ambulance personnel and equipment?	Very Good	12	3	11	26
	Good	21	6	3	30
	Fair	7	2	0	9
	Poor	0	0	0	0
	Unsure	24	3	8	35
5. Work indoors at office or building other than your residence?	Yes	32	9	13	54
	No	32	5	9	46
(If "no" or "unsure" proceed to #8)	Unsure	0	0	0	0
6. Where is office or building located?	Residence	12	2	1	15
	Plymouth, Dux., King	4	2	4	10
	Outside EPZ	10	3	8	21
	No job/ Unsure	7	1	0	8
7. Hear sirens when at work with windows and doors closed?	Yes	12	3	3	18
	No	11	1	4	16
	Unsure	1	0	1	2
8. Hear sirens at residence with windows and doors closed?	Yes	53	13	17	83
	No	11	1	2	14
	Unsure	0	0	1	1
9. Aware of any other public emergency warning systems?	Pilgrim	55	12	20	87
	Other	2	0	1	3
	No	5	2	1	8
	Unsure	8	3	4	13

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
10. If not, aware of the Pilgrim warning?	Yes	5	2	2	9
	No	1	0	0	1
	Unsure	1	0	0	1
11. What does the Pilgrim siren mean?	Accident or warning	27	10	15	52
	Drill or test	2	1	2	5
	Malfunction	21	1	0	22
	Other	1	2	1	4
	Unsure	8	1	4	13
12. Ever heard a Pilgrim warning siren from home or job?	Home	49	12	16	77
	Job	4	3	0	7
(If "no" or "unsure" proceed to #16)	No	12	2	4	18
	Unsure	0	0	2	2
13. Can the Pilgrim siren be heard well when windows and doors are closed?					
(Home)	Well	27	8	10	45
	Not well	19	3	3	25
	Not at all	7	1	2	10
	Unsure	0	0	2	2
(Job)	Well	1	3	0	4
	Not well	2	1	0	3
	Not at all	4	0	1	5
	Unsure	1	0	1	2
14. Know location of nearest siren?					
(Home)	Yes	40	7	12	59
	No	11	5	6	22
	Unsure	3	0	1	4
(Job)	Yes	3	2	3	8
	No	0	1	0	1
	Unsure	1	0	0	1
15. How far is the siren?					
(Home)	$<$1/2 mile	26	5	9	40
	between 1/2 mile & 1 mile	10	3	6	19
	$>$1 mile	7	1	2	10
	Unsure	4	1	1	6
	Response not credible	0	1	0	1

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
15. (continued) How far is the siren?					
(Job)	< 1/2 mile	1	0	2	3
	between 1/2 mile & 1 mile	0	1	1	2
	> 1 mile	0	1	0	1
	Unsure	1	0	0	1
	Response not credible	0	0	0	0
16. First reaction to Pilgrim siren, if not drill?	Evacuate	5	1	1	7
	Shelter	5	0	2	7
	Radio or T.V.	12	4	3	19
	Emergency Broadcast System station	6	2	1	9
	Ignore	10	3	4	17
	Unsure	12	2	3	17
	Test or malfunction	7	2	4	13
	Call police	6	1	0	7
	other	3	1	4	8
17. Can you name an Emergency Broadcast System station?	Yes	40	6	13	59
	No	24	8	9	41
18. Ever heard Pilgrim siren go off accidentally?	Yes	51	11	15	77
	No	9	2	7	18
(If "no" or "unsure" proceed to #20)	Unsure	1	0	1	2
19. How many times?	1	8	0	2	10
	2	7	3	5	15
	3-7	25	7	7	39
	8 or more	9	1	1	11
20. How would you determine whether a siren was a false alarm?	Call someone	19	2	8	29
	Radio or T.V.	28	8	10	46
	Other	9	1	1	11
	Unsure	10	3	4	17
21. How much do you feel you know about emergency procedures in case of an accident at Pilgrim?	Great deal	4	0	2	6
	Some	19	3	7	29
	Not much	28	8	8	44
	None	11	3	2	16
	Unsure	1	0	3	4
22. How did you learn what you know about emergency procedures?	Media	19	5	8	32
	Official Brochure	24	3	8	35
	Word of mouth	7	1	3	11
	Other	14	4	3	21

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
23. Have you received Emergency Public Information Brochure?	Yes	45	9	13	67
	No	16	3	7	26
(If "no" or "unsure" proceed to #29)	Unsure	2	2	2	6
24. When?	Sept "82"	3	1	2	6
	Oct "82"	0	0	0	0
	Fall "82"	6	0	2	8
	Other "82"	11	2	5	18
	Fall "81"	0	0	0	0
	Other	5	2	1	8
	Unsure	20	3	2	25
25. Did you read the brochure?	Completely	24	3	11	38
	Partially	16	6	2	24
	Not at all	5	0	1	6
26. Was it helpful?	Very	11	0	2	13
	Somewhat	25	8	8	41
	Not at all	6	1	2	9
	Unsure	1	0	2	3
27. Do you have the brochure available right now?	Yes	16	1	4	21
	No	29	8	10	47
28. Where is it kept?	Location given	14	1	2	17
	Unsure	8	0	2	10
29. Any questions regarding emergency planning?	Yes	23	6	11	40*
	No	41	8	11	60
* The response of one Plymouth man was "Why can't they improve the sirens so people would believe them?"					
30. Dangerousness of accident at Pilgrim?	Very	27	8	6	41
	Somewhat	23	4	10	37
	Not at all	8	1	3	12
	Unsure	5	1	2	8
	Not immediate	1	0	1	2
	Too early to tell	0	0	0	0
31. What is the safest location?	Home	15	2	6	23
	Basement	9	6	5	20
	Under table/bed	0	0	0	0
	Public Shelter	1	1	1	3
	Car	2	0	0	2
	Other	37	5	11	53

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
32. If ordered to evacuate, where would you go?					
	Hanover Mall	6	5	3	14
	Bridgewater St. Coll.	2	0	0	2
	Taunton Hosp.	1	0	0	1
	Wherever directed	7	1	7	15
	To friends of family	15	2	5	22
	Just away, no particular destination	15	3	3	21
	Don't know	10	3	2	15
	Would not evacuate	6	0	1	7
	Other	0	0	1	1
33. How would you get there?	Own Car	49	12	18	79
	Other Car	3	1	0	4
	Public Transportation	1	0	0	1
	Other	4	0	4	8
	Unsure	4	1	0	5
34. Do you have a car available?					
(Weekdays)	Yes	53	11	21	85
	No	9	2	0	11
	Sometimes	1	1	1	3
	Unsure	0	0	0	0
(Weeknights)	Yes	55	11	21	87
	No	7	1	0	8
	Sometimes	1	2	1	4
	Unsure	0	0	0	0
(Weekends)	Yes	56	11	21	88
	No	7	1	0	8
	Sometimes	0	2	1	3
	Unsure	0	0	0	0
35. What if no car were available?	Call Spouse	1	2	0	3
	Neighbor	31	6	13	50
	Non-Neighbor	3	1	0	4
	Walk	4	1	1	6
	Public Transportation	6	0	3	9
	Contact Town Authority	0	0	1	1
	Would not evacuate	7	1	3	11
	Other	6	3	1	10
	Unsure	8	0	0	8

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
36. If ordered to take shelter what would you do?	Own basement	26	9	13	48
	Home-not basement	12	0	3	15
	Neighbor basement	0	3	0	3
	Public Shelter	6	1	1	8
	Evacuate	5	1	1	7
	Other	7	0	3	10
	Unsure	8	1	2	11
37. Do you have a basement (if not mentioned above)?	Yes	25	4	8	37
	No	13	1	1	15
38. Which provides greater protection: car or basement?	Car	7	0	2	9
	Basement	45	12	15	72
	Unsure	14	2	5	21
39. A cloud of radioactivity would be visible during the day.	Agree	3	3	1	7
	Somewhat agree	14	0	4	18
	Disagree	23	6	7	36
	Somewhat disagree	13	3	5	21
	Unsure	13	2	5	20
40. The exposure to radiation from an accident would be the same as a chest x-ray.	Agree	0	2	1	3
	Somewhat agree	8	0	1	9
	Somewhat disagree	10	0	0	10
	Unsure	8	2	3	13
	Disagree	39	10	17	66
41. Boston Edison made a correct decision to cancel Pilgrim II.	Agree	31	8	9	48
	Somewhat agree	4	0	1	5
	Somewhat disagree	7	3	2	12
	Disagree	18	1	7	26
	Unsure	5	2	2	9
	Refused	0	0	1	1
42. Pilgrim officials have done everything possible for public awareness of emergency procedures.	Agree	15	2	7	24
	Somewhat agree	18	6	5	29
	Somewhat disagree	11	3	3	17
	Disagree	13	4	5	22
	Unsure	6	0	2	8
43. Death is possible within a few months of exposure to radiation during a major Pilgrim accident.	Agree	16	8	6	30
	Somewhat agree	20	0	6	26
	Somewhat disagree	10	3	2	15
	Disagree	6	1	2	9
	Unsure	10	2	6	18

Telephone Survey of 100 Residents in the Emergency Planning Zone: Summary of Results

Question		Plymouth 64 Respondents	Kingston 14 Res.	Duxbury 22 Res.	Total
44. Vote on question 3.	Yes	31	9	11	51
	No	6	2	7	15
	Didn't Vote	19	2	2	23
	Unsure	5	1	2	8
	Refused	1	0	0	1
45. Political Classification?	Conservative	20	8	6	34
	Moderate	24	3	11	38
	Liberal	11	1	2	14
	Unsure	10	2	3	15
46. Marital Status?	Single	13	3	6	22
	Married	42	10	14	66
	Divorced or Separated	1	0	2	3
	Widowed	9	1	0	10
	Refused	0	0	0	0
47. Any physically disabled in household?	Yes	3	1	2	6
	No	58	13	20	91
48. Age group	18 - 24	9	2	1	12
	25 - 34	10	2	6	18
	35 - 44	14	5	6	25
	45 - 54	5	1	1	7
	55 - 64	9	0	3	12
	65 +	17	4	5	26
	Refused	0	0	1	1
49. Highest Level of Education?	Grade School	3	0	0	3
	Some High School	1	2	1	4
	High School Grad.	26	5	4	35
	Some College	17	3	9	29
	College Graduate	11	2	4	17
	Post Graduate Work	4	2	4	10
	Refused	0	0	0	0

INTERVIEWER ______________________ PHONE NUMBER ____________

DATE ______________ TOWN ______________________________

PILGRIM EMERGENCY PLANNING SURVEY

"Hello, my name is ___________. I'm calling from Opinions Unlimited, a Massachusetts polling firm. We're doing a survey on emergency response in your area and we've selected your phone number at random. I'd like to get your opinion on a few things if I may? (IF YES, PROCEED) First of all, are you a resident of ________________?" (IF YES, PROCEED)
(same town as above)

1. "What is your opinion of fire response capability in your area regarding response time to emergency calls? Would your rating be . . ." (READ CHOICES)
   "Very Good" ------------------1
   "Good" ----------------------2
   "Fair" ----------------------3
   "or Poor" -------------------4
   (Unsure)(DO NOT READ) ---------5

2. "What is your opinion of the quality of the fire personnel and equipment in your area? Would your rating be . . ."(READ CHOICES)
   "Very Good" ------------------1
   "Good" ----------------------2
   "Fair" ----------------------3
   "or Poor" -------------------4
   (Unsure) (DO NOT READ) --------5

3. "What is your opinion of ambulance response capability in your area regarding response time to emergency calls? Would your rating be . . ." (READ CHOICES)
   "Very Good" ------------------1
   "Good" ----------------------2
   "Fair" ----------------------3
   "Poor" ----------------------4
   (Unsure) (DO NOT READ) --------5

"What is your opinion of the quality of ambulance personnel and equipment in your area? Would your rating be . . ." (READ CHOICES)
   "Very Good" ------------------1
   "Good" ----------------------2
   "Fair" ----------------------3
   "Poor" ----------------------4
   (Unsure) (DO NOT READ) --------5

"Do you ever work indoors at an office or building other than your residence?"
   Yes (INCLUDE SOMETIMES) ------1
   No ------------------- -----2 }- SKIP TO Q. 3
   Unsure -----------------------3 }

6. "In what town is that office or building located?"

Town ______________________________

Same as residence ------------------1

Not same as residence, but job in Plymouth, Kingston or Duxbury --2

All other towns --------------------3 } SKIP TO Q.8

No job/ Unsure ---------------------4 }

7. "When you are working indoors at that office or building other than your residence, can you hear police, fire or ambulance sirens if the windows and doors are closed?"

Yes --------------------------------1

No ---------------------------------2

Unsure -----------------------------3

8. "Can you hear police, fire or ambulance sirens at your residence when your windows and doors are closed?"

Yes --------------------------------1

No ---------------------------------2

Unsure -----------------------------3

9. "Are you aware of any other public emergency warning systems?" (DO NOT READ)

Pilgrim Nuclear Warning------1 (SKIP TO Q. 11)

All others-------------------2

No---------------------------3

(ACTUAL RESPONSE IF "OTHER"____)

(IF PILGRIM WARNING NOT MENTIONED, ASK):

10. "Are you aware of a warning siren in case of an accident at the Pilgrim Nuclear Power Plant?"

Yes-------------1

No--------------2 } (SKIP TO Q.11)

Unsure----------3 }

(IF AWARE OF PILGRIM SIREN, ASK):

11. "What does the Pilgrim siren mean?" (DO NOT READ)

Accident--------1
Drill-----------2
Other-----------3
Unsure----------4
(ACTUAL RESPONSE IF "OTHER"________________________________
____)

12. "Have you ever heard the Pilgrim warning siren from your home or job?

Home------------1
Job-------------2
No--------------3
Unsure----------4 (SKIP TO Q. 16)

(IF SIREN HAS BEEN HEARD AT EITHER HOME OR JOB, ASK):

13. "Can you hear the Pilgrim warning siren well at [your home and/or your job (DEPENDING ON ANSWER TO Q. 6)] when the windows and doors are closed?"

Home	Job
Well------------1	Well------------5
Not well--------2	Not well--------6
Not at all------3	Not at all------7
Unsure----------4	Unsure----------8

14. "Do you know the location of the siren nearest to your [home and/or job (AS APPROPRIATE)]?"

Home	Job
Yes-------------1	Yes-------------4
No -------------2	No--------------5
Unsure----------3	Unsure----------6

(IF YES FOR HOME OR JOB, ASK):

15. "How far would you estimate the siren is from your [home and/or job (AS APPROPRIATE)]?" (READ FIRST THREE CHOICES)

"Less than ½ mile"---1	"Less than ½ mile"---6
"Between ½ a mile and one mile"--------2	"Between ½ a mile and one mile"--------7
"Over one mile"------3	"Over one mile"------8
Unsure (DON'T READ)--4	Unsure (DON'T READ)--9
Answer given, but interviewer doubts credibility----------5	Answer given, but interviewer doubts credibility---------10

16. "What would be your first reaction if you heard the Pilgrim and a drill was not scheduled?" (DO NOT READ)

    Evacuate--------------------1
    Take shelter----------------2
    Turn on radio or TV---------3
    Turn on radio or TV to an Emergency Broadcast Station--4
    Ignore----------------------5
    Unsure----------------------6
    All other-------------------7
    (ACTUAL RESPONSE IF "OTHER" ______

17. "Can you name one of the Emergency Broadcast Stations on radi in your area?" (CORRECT ANSWERS: WBZ-TV CHANNEL 4; WBZ 1030 WATD 96 FM, WPLM 1390 AM/99.1 FM)

    Yes-------------1
    No--------------2

    (IF THEY ASK FOR THE NAMES, GIVE THEM)

18. "Have you ever heard a Pilgrim siren go off accidentally, when it wasn't supposed to?

    Yes-------------1
    No--------------2 } (SKIP TO Q. 20)
    Unsure----------3 }

    (IF YES),

19. "How many times have you heard a Pilgrim siren go off accident

    Once------------1
    Twice-----------2
    Over 2----------3 (ACTUAL RESPONSE IF OVER 2: ______

20. "If you heard the siren in the future, how would you determine whether it was a false alarm?" (DO NOT READ)

    Call someone--------------1
    Turn on Radio or TV-------2
    Other---------------------3
    Unsure--------------------4
    (ACTUAL RESPONSE, IF "OTHER" ______

21. "How much do you feel you know about emergency procedures in the case of a nuclear accident at Pilgrim? Do you feel you know a great deal; some, but not a great deal; very little; or nothing at all?"

    A great deal-----------1
    Some-------------------2
    Not much, very little---3
    Nothing----------------4
    Unsure-----------------5

22. "How did you learn what you do know about emergency procedures in case of an accident at Pilgrim?" (DO NOT READ)

    TV, radio, newspaper------------------------1
    Official Emergency Planning Brochure---------2
    Word of mouth-------------------------------3
    Other---------------------------------------4
    (ACTUAL RESPONSE IF "OTHER" ______________________________)

23. "Have you ever received an Emergency Public Information Brochure in the mail?"

    Yes------------1
    No-------------2 (SKIP TO Q. 29)
    Unsure---------3 (SKIP TO Q. 29)

(IF "YES", ASK):

24. "When did you receive it? Do you remember what month?"

Sept. '82-------1	Fall '81---------5
Oct. '82--------2	Other '81--------6
Fall '82--------3	Other------------7
Other '82-------4	Unsure-----------8
	(RESPONSE FOR "OTHER" ______________)

25. "Would you say you read (PRONOUNCE "red") the brochure..." (READ RESPONSES)

    "Completely",-----------1
    "Partially",------------2
    "or, Not at all".-------3 (SKIP TO Q. 27 FOR #3 ONLY)

26. "Did you find it very helpful, somewhat helpful, or not at all helpful?"

    Very-------------------1
    Somewhat---------------2
    Not at all-------------3
    Unsure-----------------4

27. "Do you have your emergency brochure available right now?"

    Yes-------------1
    No--------------2 (SKIP TO Q. 29)

(IF YES),

28. "Where do you keep it?" (DON'T PRESS FOR AN ANSWER)

If location given---------1

Unsure of location--------2

ASK EVERYONE

29. "Do you have any questions regarding emergency planning in the case of a nuclear accident at Pilgrim I?" (IF YES: "What questions?")

____

____

____

____

Let's imagine for a moment that the warning siren has indicated that there had been a nuclear accident at Pilgrim I.

30. "As far as you know, how dangerous is the situation? Would you consider the situation to be . . ." (READ CHOICES)

"Very dangerous",- - - - - - - - - 1

"Somewhat dangerous",- - - - - - - 2

or "Not at all dangerous",- - - - - 3

Unsure- - - - - - - - - - - - - - 4 (DO NOT READ)

No immediate danger - - - - - - - 5 (DO NOT READ)

Too early to tell - - - - - - - - 6 (DO NOT READ)

31. "Where do you believe is the safest location for you during this situation?" (if siren indicates an accident at Pilgrim)(DO NOT READ)

Home - - - - - - - - - - - - - - - - 1

Basement - - - - - - - - - - - - - - 2

Under table or bed - - - - - - - - 3

Public shelter - - - - - - - - - - 4

Car- - - - - - - - - - - - - - - - - 5

Other - - - - - - - - - - - - - - - 6

(ACTUAL RESPONSE IF "OTHER" ______________________________

____)

32. "If you were ordered to evacuate because of an accident at Pilgrim where would you go?" (DO NOT READ)

Hanover Mall - - - - - - - - - - - 1

Bridgewater State College - - - 2

Taunton State Hospital - - - - - 3

Wherever directed- - - - - - - - 4

Other - - - - - - - - - - - - - - - 5

(ACTUAL RESPONSE IF "OTHER" ______________________________

____)

33. "How would you get there?" (DO NOT READ)

Personal car - - - - - - - - - - - - - - - - - - -1
Other car (neighbor, relative, friend) - - - -2
Public transportation - - - - - - - - - - - - -3
Other- -4
Unsure -5
(ACTUAL RESPONSE IF "OTHER" ____________________
____)

34. "Do you have a car available for your use?"

"Weekdays"	"Weeknights"	"and Weekends"
Yes - - - - - 1	Yes - - - - - 5	Yes - - - - - 9
No- - - - - - 2	No - - - - - 6	No - - - - - 10
Sometimes - - 3	Sometimes - - 7	Sometimes - - 11
Unsure- - - - 4	Unsure- - - - 8	Unsure - - - 12

35. "What would you do if you were ordered to evacuate and you had no car available?" (DO NOT READ)

Phone spouse - - - - - - - - - - - - - 1
Contact neighbor for a ride - - - - 2
Phone non-neighbor for a ride - - - 3
Walk away- - - - - - - - - - - - - - - 4
Walk to public "staging area" for public transportation - - - - 5
Take shelter - - - - - - - - - - - - - 6
Other- - - - - - - - - - - - - - - - - - 7
Unsure - - - - - - - - - - - - - - - - - 8
(ACTUAL RESPONSE IF "OTHER" ____________________
____)

36. "If you were ordered to take shelter because of an accident at Pilgrim I, where would you go?" (DO NOT READ)

Own basement - - - - - - - - - - - - - 1
Home - other than basement - - - - - 2
Neighbor's basement - - - - - - - - - 3
Public shelter - - - - - - - - - - - - 4
Evacuate - - - - - - - - - - - - - - - - 5
Other - - - - - - - - - - - - - - - - - 6
Unsure - - - - - - - - - - - - - - - - - 7
(ACTUAL RESPONSE IF "OTHER" ____________________
____)

37. IF "OWN BASEMENT" or "CELLAR", NOT MENTIONED, ASK:

"Does your home have a basement?"

Yes - - - - - - 1

No - - - - - - 2

38. "Which would provide greater protection from radiation?"

"your car", - - - - - - - - - 1

"or your basement", - - - - 2

unsure - - - - - - - - - - - - 3 (DON'T READ)

"I'd like to read you five statements. Please tell me if you completely agree, somewhat agree, somewhat disagree or completely disagree with each statement."

39. "If a cloud of radioactivity were released during an accident at Pilgrim, it would be visible during the day."

Completely agree - - - - - - - - - -1

Somewhat agree - - - - - - - - - - -2

Somewhat disagree - - - - - - - - -3

Completely disagree - - - - - - - -4

Unsure - - - - - - - - - - - - - - - -5

40. "The exposure to a person outdoors from the radiation released during a major accident at Pilgrim would be about the same as the exposure from a chest X-ray."

Completely agree - - - - - - - - - -1

Somewhat agree - - - - - - - - - - -2

Somewhat disagree - - - - - - - - -3

Completely disagree - - - - - - - -4

Unsure - - - - - - - - - - - - - - - -5

41. "Boston Edison made the correct decision when they cancelled plans to build Pilgrim II, a second nuclear powered generating plant."

Completely agree - - - - - - - - - -1

Somewhat agree - - - - - - - - - - -2

Somewhat disagree - - - - - - - - -3

Completely disagree - - - - - - - -4

Unsure - - - - - - - - - - - - - - - -5

42. "The emergency officials at Pilgrim I have done everything they could to insure maximum public awareness of emergency procedures."

    Completely agree - - - - - - - - - - - - 1
    Somewhat agree - - - - - - - - - - - - - 2
    Somewhat disagree - - - - - - - - - - - 3
    Completely disagree - - - - - - - - - - 4
    Unsure - - - - - - - - - - - - - - - - - 5

43. "The exposure to a person outdoors from the radiation released during a major accident at Pilgrim could cause death within a few months."

    Completely agree - - - - - - - - - - - - 1
    Somewhat agree - - - - - - - - - - - - - 2
    Somewhat disagree - - - - - - - - - - - 3
    Completely disagree - - - - - - - - - - 4
    Unsure - - - - - - - - - - - - - - - - - 5

44. "Did you vote "Yes" or "No" on Question 3 on the November ballot? Question 3 proposed a law that would require that all construction or operation of new nuclear power plants or radioactive waste disposal facilities be subject to voter approval in statewide elections."

    Yes - - - - - - - - - - 1
    No - - - - - - - - - - 2
    Didn't vote - - - - - 3
    Unsure - - - - - - - 4
    Refused - - 5

"Finally, I just have a few questions for classification purposes."

45. "Politically, do you consider yourself to be a..." (READ CHOICES)
"Conservative",-------1
"Moderate",-----------2
"or, Liberal"---------3
(DO NOT READ) Unsure--4

46. "What is your marital status?" (READ CHOICES)
"Single",-----------------1
"Married",----------------2
"Divorced or separated",---3
"or, Widowed".-------------4
Refused-------------------5

"How many people including yourself, live in your home?"
(RECORD NUMBER______________)

47. "Are there any physically disabled persons living in your household?"
Yes-------------1
No--------------2

48. "In which of the following groups is your age?" (READ CHOICES)
"18-24"----------------1
"25-34"----------------2
"35-44"----------------3
"45-54"----------------4
"55-64"----------------5
"65 and over"----------6
Refused--------------7

49. "What is the highest level of education you have achieved?" (READ CHOICES)
"High school graduate"-----------1
"Some college"-------------------2
"College graduate"---------------3
"Post-graduate work or degree"----4
Refused-------------------------5

"Thank you very much for your assistance. Good-bye."

50. (RECORD SEX) FEMALE-----------1 MALE --------------2

APPENDIX B

MAJOR CAMPS AND CAMPGROUNDS

MASSPIRG contacted each of the major camps and campgrounds in the Emergency Planning Zone to determine the extent of their participation in Civil Defense evacuation plans.

MASSPIRG asked the respondent at each camp for the following information:

1) whether the camp had been contacted by the Civil Defense for participation in any evacuation plan;

2) whether the camp had any organized plans for evacuation in the event of an emergency at the Pilgrim nuclear plant;

3) the transportation which would be available to evacuate persons in the camp:

4) the number of vehicles available to evacuate campers;

5) the number of counselors or aides at the camp;

6) whether the aides would be able to assist in an evacuation;

7) the number of campers currently in the camp or campground;

8) whether the camp had received an Emergency Public Information Brochure; and

9) whether the emergency information is distributed to the campers.

Camp	Contacted for participation?	Have evacuation Plans?	Transportation plans	Number of vehicles on hand	Number of counselors or aids	Aids assist in evacuation?	Number of campers	Seen brochure?	Is it distributed to campers?
Ellis Haven 746-0803 Carol Black	No Siren used to be set off by lightning. Set by deer pen in a valley - severely disturbs deer but cannot be heard in the camp which is on hill.	No	Camper's own vehicles	1 or 2 per family	None	-	400 families	No	No but "would be a good idea"
Camp Squanto 224-2010 and Camp Child 224-2280 Joseph Piche Supervisor of camps	No	No Impossible to evacuate the number of people in camp.	None	Only staff vehicles. No transportation for the children.	115 for both camps together	yes	400 children per week	yes - posted	No
Indian Head Campgrounds Stan Atkins 888-3688	No	No	None "every man for himself"	1 per family	3 - 4 staff members	not certain	200 families	No if received, did not read it	No wouldn't distribute to campers- might scare them away
Totals	0/4	0/4	0/4 Camper's own vehicles	Camper and staff vehicles only	118 - 119	2/4	600 families and 400 children per week	2/4	0/4

APPENDIX C

TOWN CIVIL DEFENSE DIRECTORS IN THE EPZ

MASSPIRG called each of the 6 Civil Defense numbers listed in the most current Emergency Public Information Brochure. None of the numbers listed in the brochure reach a Civil Defense official, and in each case it took several calls before MASSPIRG could find out the phone number where the Civil Defense director could be reached. Both the listed number and the number where the director can actually be reached have been included in the summary of responses from each director.

When contacted, each Civil Defense director was asked for the following information:

1. the number of handicapped persons who had called him about their evacuation needs; and
2. what vehicles would be used to evacuate handicapped persons.

Town, Civil Defense Director	Phone number listed in the Emergency Public Information Brochure	Actual Phone Number	Number of Handicapped who have called	Evacuation vehicles	Comments
Plymouth, James W. Ryan	746-4039[1] 746-4186	769-6900 ext. 255 (business)	0	Any school buses on hand[2] or private ambulances, or police cars, or fire vehicles, or Dept. of Public Works vehicles	1. The phone numbers listed in the brochure do not reach the Civil Defense director, who works in Norwood, 30 miles away. If there is someone to answer the call, the caller will be given Mr. Ryan's business number. 2. Mr. Ryan commented that there was "no way everyone can be evacuated" from Plymouth in case of an accident at Pilgrim, but asserted that the possibility of having to evacuate the whole town is "practically nil."
Carver, David Pierce (temporary dir.)	866-4444 (police alarm)	866-4045[3] (police & fire business line)	0	1 Civil Defense car 1 van; possibly school buses and volunteer cars	3. This number does not reach Mr. Pierce since he does not work at the police or fire department. MASSPIRG was given Mr. Pierce's business number and had to leave a message with his answering service.
Duxbury Carl O'Neil (fire chief)	934-6586 (town hall)	934-5691 (fire station)	0	1 Senior Citizens' vehicle[4]	4. Mr. O'Neil stated that they will depend chiefly on the Massachusetts Civil Defense for the evacuation of handicapped persons.
Kingston, Robert Mulliken	585-4445 (selectman's office)	585-2743[5] (home)	1	None Volunteer cars only and possibly the town ambulance, which has a capacity of 1 or 2	5. MASSPIRG called 14 times within 4 days before reaching anyone at Mr. Mulliken's home number, which was given by the selectman's office.
Marshfield, Dan McConagle	837-5141 (town hall)	834-4959[6] (home)	20[7]	6 vehicles specially equipped for the handicapped, with a capacity of 4 each.	6. After several calls, MASSPIRG reached Mrs. McConagle who explained that her husband was "not home very often" to receive phone calls. 7. Marshfield conducted a special seminar for handicapped persons to acquaint them with emergency procedures.

APPENDIX D

PLYMOUTH CORRECTIONAL FACILITIES

MASSPIRG contacted each of the correctional facilities in the Plymouth area about its plans in the event of an evacuation and the extent of its contact with the Civil Defense. MASSPIRG asked the respondent at each facility for the following information:

1) whether the facility had been contacted by the Civil Defense for participation in any evacuation plans;
2) the facility's plans for evacuation in the event of an emergency at the Pilgrim nuclear plant;
3) the means of transportation for evacuation of the inmates in the facility;
4) the number of vehicles available for evacuation transport and the capacity of those vehicles; and
5) the current number of inmates at the facility. The Plymouth plan's estimate of the number of inmates residing in the facility during peak use is included for comparison with the number of inmates currently residing in the facility.

Facility	Contacted about evacuation plan	If so what are the plans?	Means of transportation of inmates	# of vehicles on hand, capacity	# inmates	Plymouth plan estimate of peak use 1980
Plymouth Co. Jail (County Farm) 746-3040 Doug Abde, Deputy, Civil Defense Director for Jail 746-0610	Yes, contacted by the Civil Defense Notification of an emergency is a serious problem since sirens cannot be heard and they have no other means of direct notification	Official procedure is to call the National Guard for aid in evacuation. Of special concern are: 1) the facility has as residents both minor and dangerous offenders, 2) the number of staff members on hand at any one time may be as few as 5 or 6, and 3) the uncertainty regarding the exact destination after evacuation and the capability of whatever facilities are provided to cope with 230 possibly dangerous offenders.	"limited"	Will require outside help to evacuate - insufficient vehicles and staff. 6 vehicles, with total maximum capacity of 50.	230	155
Town of Plymouth Jail (Police Station Lockup) Tom Harwith 746-1218	No[1]	None[1]	Police cruisers	Police cruisers	0 none daytime; no more than a couple at any one time	22
MCI Plymouth Ed Riendiu Superintendent	No, contacted several years ago about a meeting, but no meeting was ever held. No contacts since. Notification is a problem: "The sirens are always going off. The staff and inmates panic and I don't know what to do - so I call the police but I can never get through."	Uncertain about where the inmates are to be evacuated to and what provisions will be made for them once they have arrived at their destination.	MCI vehicles	1 dump truck 2-3 vans, capacity of 9 each. any staff vehicles which might be available	135 50 total staff members	65
Totals	1/3 contacted	1/3 have official plan but concern that plan is not workable		8 - 9 vehicles and 1 dump truck Capacity about 75:	365	267

1) Information from interview of June, 1982. Plymouth police refused to give any new information in followup interview in June 1983.

APPENDIX E

SOUTHEAST MASS. AMBULANCE SERVICES

MASSPIRG contacted the ambulance services in Southeast Massachusetts that were listed in the Civil Defense Emergency Response Plan as being able to provide transport services for the handicapped or elderly if an evacuation of the Emergency Planning Zone became necessary.

MASSPIRG asked the respondent at each business for the following information:

1) whether the business had been contacted by the Civil Defense for participation in evacuation plans in the event of an emergency at the Pilgrim nuclear plant;

2) whether the business had prepared any organised plan for the provision of vehicles for an evacuation.

3) whether any vehicles or staff would be prepared to handle radiation victims;

4) the number of vehicles for handicapped persons and the capacity of those vehicles;

5) the number of ambulances owned by the business and the number available during the day and at night;

6) the number of amublances and vehicles for the handicapped on hand when MASSPIRG called; and

7) the response time involved in sending available vehicles to the Emergency Planning Zone.

Company	Contacted for participation	Have plans?	Prepared to handle radiation victims	Vehicles for handicapped, capacity	Number of Ambulances Total	Day	Night	On hand when PIRC called	Response Time
Shore Ambulance 748 Brockton Abington, MA 746-8888 Anne Crockett, V.P.	No	No ("would do whatever directed to do at time")	No	3 - capacity 2, 4, 5 (1 possible back-up but said she regards total as 3)	7	7	only 2 manned others available with delay	1 ambulance 1 wheelchair van	30 min.
Bristol Co. Ambulance 35 School St. Tauton, MA 824-4008 Gilbert Carnett, owner	No	No Would not send any vehicles: "if they want ambulances, they'll have to come get them. No one on my staff will go anywhere near Plymouth if there is an accident at the nuclear plant."	No	2 - 4 each	6	6	6	0	
Fallon Ambulance 95 Eliot Street Milton, MA 698-0215 Mr. Driscoll, Coordinator Mr. Fallon, owner	No	No	No	2 for wheelchairs capacity 5 each all 10 can carry stretchers	10	10	5	ambulances - 2 handicapped - 2	45 min.

-continued-

SOUTHEAST MASS. AMBULANCE SERVICES

-continued-

Company	Contacted for participation	Have plans?	Prepared to handle radiation victims	Vehicles for handicapped, capacity	Number of Ambulances Total	Day	Night	On hand when PIRG called	Response Time
Metropolitan Ambulance (63 Weir Street Taunton) P.O. Box 114 Attleboro, MA 823-2551 Allen Grotta, owner	No	No	No	4 - 3 by contract 1 owned capacity: 2 have cap. of 2 1 has cap. of 4 1 has cap. of 1	2	2	2	ambulances - 1 handicapped - 0	1 hour
Norfolk Bristol Ambulance 959 Main Street Brockton, MA 48 E. Vernon Street 587-5270 Robert Zamaib	No	No	No	4 wheelchair vans capacity - 5 each	12	12	8	ambulances - 6 handicapped - 0 (most wheelchair vans unavailable after 5 P.M.)	Attleboro Taunton Brockton
Metro Ambulance 131 Adams Street Braintree, MA 843-2600 Mike Grant, President	Yes - under contract with the city of Plymouth. However, MASSPIRG was unable to contact Metro for follow-up questions since there was no answer at the Metro number over the course of 4 days.	Will be notified by fire dept.	each is equipped with a "radiation kit" - doesn't know what type of equipment is involved. Supplied by civil defense.	0		3		3	2 min. located at fire station
Royal Ambulance 115 Sandwich Street Plymouth, MA 746-8888	No company no longer exists	-	-	-		-		-	-
Wheelchair Transit 30 Crescent Ave. Stoughton, MA 963-0140 Mr. Zapastus, owner	No	No	No	10 - capacity 4 each	2			ambulances - 2 handicapped - 0	some would be unavailable, others 1 hour +
Results	1/8 contacted for participation	1/8 has plans for provision of vehicles for an evacuation	1/8 prepared to handle radiation victims - 3 ambulances	25 vehicles for handicapped total capacity: 98	42 ambulances 28 available at night			15 ambulances on hand 3 vehicles for handicapped on hand	

APPENDIX F

PLYMOUTH NURSING HOMES

MASSPIRG called each of the nursing homes in Plymouth to determine the extent of its participation in Civil Defense evacuation plans.

MASSPIRG asked the administrator of each home for the following information:

1) whether the home had been contacted by the Civil Defense for participation in any evacuation plan;
2) whether the home had any plans for evacuation in the event of an emergency at the Pilgrim nuclear plant;
3) the number of persons currently residing in the home;
4) the number of nursing aides on each shift;
5) the number of aides who would be able to assist in an evacuation;
6) the type of transportation which would be available to evacuate the nursing home residents; and
7) whether medical care could be continued during an evacuation.

Nursing Home	Contacted for participation?	Have plans?	# of Residents	Nursing Aids (Day Eve. Night)	Aids assist in Evacuation	Transportation Capacity	Continuation of Medical Care During Evacuation
Mayflower House Mrs. Hilton, Administrator 746-4343	No	No Onsite disaster only	184 60 wheelchairs	28 20 10	Don't know Most will leave to evacuate own families	1 bus - capacity for 5 wheelchairs, 4 others Private cars if available	Yes
Pilgrim Manor Nursing Home Steven Kelly, Temporary Administrator 746-7016	No	No Onsite disaster only	176 85-125 non-ambulatory	30 24 12	Don't know	1 van - capacity for 8-10 No wheelchairs Private cars if available	Yes Depending upon staff available during evacuation
Happiness House Rest Home Mrs. McCabe, Administrator 746-2982	No Heard sirens once, once heard nothing (read about it in newspaper) "probably depends on weather & time of year"	No-onsite only. Reaction to sirens or evacuation order- "Oh my God, what would I do? I couldn't leave any of my people here." Would probably stay.	30 - 36	2 2 2	Yes	1 stationwagon (9) 2 cars (12) (staff cars)	Yes
Plymouth Nursing Home Mrs. Kerrigan, Administrator 746-2085	No Can hear sirens in summertime with windows open - doesn't know about winter	Yes own plan	37	9-10 5 3	Yes Additional nearby staff members would come to assist	7-8 vehicles always available Capacity to evacuate all res. residents (37)	Yes
Totals	0/4 contacted	1/4 have plans	427-433	69-70 51 27	2 Yes	75 - 77	4/4 Yes

APPENDIX C

HOSPITALS

In order to find out the extent of hospital awareness of, and participation in, Civil Defense radiological

emergency response plans,

In order to find out the extent of hospital awareness of, and participation in, Civil Defense radiological emergency response plans, MASSPIRG contacted Morton Hospital, which is located outside of the Emergency Planning Zone and is designated for reception of radiation victims, and Jordan Hospital, which is within the Zone and may therefore be required to evacuate as well as receive and treat radiation victims.

MASSPIRG asked the respondent at each hospital for the following information:

1) whether the hospital had been contacted by the Civil Defense for participation in emergency plans in the event of an accident at the Pilgrim nuclear plant;

2) the hospital's plans for evacuation, if any;

3) the number of persons to be evacuated;

4) the facilities available within the hospital for treatment of radiation victims and the capacity of those facilities;

5) the number of hospital staff trained for radiological accidents; and

6) the ability of the radiological treatment unit to be evacuated if an evacuation of the hospital became necessary.

Hospital	Contacted for participation	Plans for evacuation	Hospital capacity	Capacity for treatment of radiation victims: facilities	Capacity for treatment of radiation victims: maximum # of patients	Staff trained for radiological accidents	Ability of radiological treatment unit to be evacuated also
Morton Hospital Taunton, MA Dr. Herbert Haessler, Acting Director of Emergency Room 824-6911 ext. 1260	No	No evacuation	No evacuation	new emergency facilities just opened	5-6 patients at a time	None	No evacuation
Jordan Hospital Plymouth, MA Peter Chapman, Sr. V.P. 746-2000	Yes	Will be contacted by the Civil Defense 2 procedures: 1) if radiation release but no evacuation order, will seal up hospital and shelter in hospital 2) if evacuation ordered, will contact other hospitals in the area for placement after evacuation.	179	yes minor surgery room for persons with contamination injuries - i.e. plant workers	about 3 at one time	10 - 12	No special unit

The MASSPIRG Survey of Pilgrim Evacuation Planning

MASSPIRG
September 1987

N O E X I T

THE MASSPIRG SURVEY OF PILGRIM EVACUATION PLANNING

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EXECUTIVE SUMMARY

In light of the General Accounting Office's finding that no federal agency assesses public knowledge of radiological emergency procedures, MASSPIRG surveyed 363 residents of the Pilgrim nuclear power plant's Emergency Planning Zone (EPZ) to determine what people know about the official emergency plans and whether they would follow those plans in case of an accident at Pilgrim.

The key findings of this survey show that residents are even less informed about Pilgrim emergency plans than they were at the time of MASSPIRG's last such survey, conducted in 1983. Moreover, they would refuse to follow official instructions in the event of an emergency.

1. Residents have only a limited knowledge of emergency plans for their communities. Only 56% of those surveyed said they had received the Emergency Public Information booklet from Boston Edison, the operator of the plant, compared with 67% who remembered receiving the booklet in 1983. Moreover, only 23% of those surveyed said they had actually read the booklet completely, compared to 38% in 1983. Those living in the EPZ for three years or less have been particularly ill-informed: 47% had not received a copy of the booklet.

2. Many residents would not follow the emergency plans in case of a serious problem at Pilgrim:

* the most common response to an accident at Pilgrim (27% of those polled) would be immediate evacuation -- a direct contradiction of instructions contained in the emergency information booklet;

* only 19% of those questioned said they would go to one of the designated reception centers in case of an evacuation, and two-thirds of these few who would follow the emergency plans would go to the Hanover Mall, which is no longer an official reception center;

* of the 37% surveyed who have school-age children, nearly half (48%) said that they would try to pick up their children from school in the event of an emergency -- precisely what the emergency booklet instructs them not to do; just 9% of parents said they would follow the instructions to meet their children outside the danger zone.

3. The emergency plans do not adequately take into account the special needs of children and the elderly.

4. Seventy-nine percent of the respondents felt that Pilgrim should remain shut down if management and safety problems persist.

5. When asked whom they would trust for information in the event of an accident, 31% of respondents said they would have no confidence in Boston Edison, easily the worst score among the people and groups mentioned.

Since the accident at Three Mile Island, the Nuclear Regulatory Commission has required communities within a 10-mile radius of a plant to have workable evacuation plans. In July 1987, the Federal Emergency Management Agency (FEMA) found the Pilgrim plans inadequate to protect public health and safety and withdrew its interim approval of them. The findings in MASSPIRG's report clearly show that, given the current level of information, the Pilgrim emergency plans would not adequately protect the public even if the deficiencies identified by FEMA were corrected.

In light of these results and serious management and safety problems at Pilgrim, MASSPIRG recommends that the Pilgrim plant should not reopen unless it is determined that:

(1) workable plans can be developed;

(2) such plans have been effectively disseminated and implemented, and

(3) outstanding management, safety, and economic questions have been resolved.

I. INTRODUCTION: THE LESSONS OF CHERNOBYL

The Chernobyl disaster in April of 1986 provided a sobering glimpse of the large-scale devastation that could result from a nuclear power plant accident. The Soviet government was forced to evacuate 135,000 people living within an 18.6-mile radius around the plant. Thirty-one people have already died as a direct result of the accident, and 24,000 more are expected to die of cancer caused by radiation exposure. Fallout from the plant contaminated crops and dairy products across Eastern Europe and was detected as far away as the west coast of the United States. On June 18, 1987, the Boston Globe quoted Konstantin Fursov, a Soviet official, to the effect that 27 cities and villages within an 18-mile radius of the plant are "too contaminated for people to live in for the foreseeable future." The world learned -- the hard way-- that accidents can and will happen, with devastating consequences.

The Chernobyl accident helped fuel the debate in the United States about nuclear power in general, and in Massachusetts over safety and evacuation issues at the troubled Pilgrim nuclear power plant.

HISTORY

Licensed in 1972, the Pilgrim reactor in Plymouth, Massachusetts, has led a tortured life. Initially, the plant was loaded with "bad" fuel which substantially increased the radioactivity in the plant. As a result of this and other problems, Pilgrim has only produced about half as much energy as it would if it had been working continuously at full power over its life today.

In 1982, Boston Edison, the owner and operator of the Pilgrim plant, received the largest fine levied against a power plant at that time, for two safety violations and a "material false statement." The Nuclear Regulatory Commission (NRC) was so concerned about conditions at Pilgrim that it ordered the utility to conduct a "management overhaul" in that same year.

Despite promises to improve its operations in 1982, the plant continued to receive poor grades from the NRC in its periodic management performance reports.

RECENT HISTORY

In early April of 1986, the reactor experienced two "unexplainable automatic shutdowns" or "scrams," touching off 17 months of harsh criticism from the NRC, elected officials and citizen groups across the state about Pilgrim's problems. In a May 1986 Congressional hearing, the NRC labeled Pilgrim one of the "worst managed and least safe plants in the country." The morning papers began to carry headlines such as "Pilgrim Missed Another Deadline for Safety Tests, "Pilgrim Workers' Radiation Exposure Among Nation's Highest," and "New Doubts Voiced on Future of Pilgrim."

The Department of Public Utilities issued a scathing indictment of Boston Edison in June of that year accusing the company's management of being "paralyzed" to the point where officials are no longer able to properly run the plant. The 300-page report stated that if Edison continued along its current path, "it will jeopardize the health and safety of its customers and the economy of the region."

After documenting years of management, structural, and evacuation problems at the plant, MASSPIRG submitted a 50-page petition to the NRC asking the Commission to suspend Pilgrim's license until all of the safety issues were resolved, and to hold a comprehensive public hearing to discuss each problem. Joining MASSPIRG in filing the "Show Cause" petition were over 50 state legislators, a dozen citizen groups, and statewide candidates for attorney general and lieutenant governor. The theme of the petition was that taken individually, the problems described are serious. In the aggregate, they thoroughly compromise the reliability of the most important safety systems

the plant and destroy the fundamental principle of defense-in-depth espoused by the NRC.

Some of the emergency planning deficiencies noted in the petition were:

1) Lack of advance information about emergencies for residents, transients, and tourists;

2) Lack of adequate medical facilities to treat contaminated individuals in the event of an emergency;

3) Lack of emergency plans for Cape Cod, located 11 miles from the Pilgrim plant, and other communities just outside the official evacuation planning zone;

4) A lack of attention to emergency planning by federal, state and local government agencies;

5) Lack of adequate capability and planning for notification during an accident, and

6) Lack of adequate plans for evacuating the physically disabled, nursing home residents, school children, hospital patients, campers, and inmates of correctional facilities.

Secretary of Public Safety Charles Barry underscored the problem areas noted in the petition in a 100-page report to the Federal Emergency Management Agency (FEMA) in December of 1986. At a December State House hearing, Governor Dukakis submitted that report and stated that Pilgrim should remain closed until all previously identified management, reactor safety and emergency planning concerns have been adequately addressed.

In light of this criticism, Edison should have been well on its way toward cleaning up its management and safety problems by 1987. But the most recent NRC performance report (No. 50-293/86-99, dated April 8, 1987) concludes that there are "significant recurring program weaknesses ... and that the rate of change was slow during most of the assessment period." In five of the twelve functional areas graded by the NRC, Pilgrim received the lowest possible score. These developments and others led a special legislative committee on Pilgrim to issue yet another report critical of the plant and its operations in July 1987.

EVACUATION PLANNING TODAY

After the accident at Three Mile Island in 1979, the NRC required nuclear plants to have workable emergency evacuation plans for the population living within a 10-mile radius around the plant. In the case of the Pilgrim plant, Boston Edison's record of safety violations and management problems makes the existence of feasible evacuation plans that much more critical.

After 17 months of shutdown, however, there is still no progress on the workability of emergency plans for the Pilgrim area. On August 6, 1987, FEMA released a report, entitled "Self-Initiated Review and Interim Finding," which further criticized Pilgrim's emergency plans and found them "inadequate to protect the health and safety of the public in the event of an accident." The five reasons highlighted in the FEMA finding were:

* Lack of evacuation plans for public and private schools and day-care centers;

* Lack of a reception center for people evacuating to the north;

* Lack of identifiable public shelters for the beach population;

* Inadequate planning for the evacuation of the special needs and transport dependent population;

* Overall lack of progress in planning and apparent diminution in emergency preparedness.

Many of the inadequacies cited in the FEMA report had been raised years before by MASSPIRG in its 1977 and 1983 reports on evacuation planning, entitled "Blueprint for Chaos" I & II, and most recently in the July 1986 "Show Cause" petition. Because several conditions which affect emergency planning have worsened in the past few years, MASSPIRG decided to follow up its earlier reports with this study.

The 1977 and '83 reports generally looked at the adequacy of emergency plans themselves, as did the recent FEMA study. This report approaches the

emergency plans from a different angle -- it looks not at the plans themselves but at the people who will be asked to follow them. Such information is crucial to assessing the feasibility of the plans, particularly in light of the General Accounting Office's finding that "no federal agency assesses public knowledge of radiological emergency procedures." (GAO Report to Hon. Edward J. Markey, House of Representatives, "Nuclear Regulation: Public Knowledge of Radiological Emergency Procedures," June 1987, p. 1.)

MASSPIRG surveyed 363 people who live in the Pilgrim Emergency Planning Zone (EPZ) to answer these basic questions:

(1) Are EPZ residents knowledgeable about the emergency plans?

(2) Will residents be willing and able to follow these plans?

(3) What do residents think about emergency planning and the Pilgrim nuclear plant in general?

The survey methodology, along with the precise questions and answers are described in Section III.

II. SURVEY RESULTS: PILGRIM DISASTER PLANS ARE STILL A DISASTER

A. PILGRIM-AREA RESIDENTS ARE INADEQUATELY INFORMED ABOUT EMERGENCY PLANNING

The first major conclusion to be drawn from our survey is that the residents of Plymouth, Kingston, Duxbury and Carver have, on the whole, a very limited knowledge of the emergency plans for their communities, and that they are even less well informed now than they were four years ago. This conclusion is apparent from the responses to virtually every survey question which tested familiarity with the basics of the emergency plans, from warning methods to evacuation procedures.

A large share of the blame for this situation must be attributed to Boston Edison's failure to educate the public. The company has relied almost solely on its booklet, "Emergency Public Information: What To Do In Case of an

Emergency at Pilgrim Nuclear Power Station," and claims to have distributed copies of it to all residents of the EPZ in November 1986. There have obviously been distribution problems: just over half (56%) of those surveyed said they had received the booklet (see Question 9). This figure represents a noticeable step backwards from 1983, the last time MASSPIRG surveyed EPZ residents. In 1983, 67% of those surveyed said they had received a copy of the emergency planning booklet.

An added problem with relying heavily on written information is that not everyone who gets it reads it. Nearly two-thirds (62%) of those who received the booklet admitted to us that they had read it only partially or had not read it at all (see Table 1, below). Thus, while 56% of the total sample remembered receiving the emergency information booklet (Q. 9), a mere 23% had read it all the way through. In 1983, 38% of those surveyed by MASSPIRG said they had read the booklet completely. The lack of public education suggested by these numbers is verified by the answers to several other questions.

TABLE 1

SURVEY RESPONDENTS WHO HAD READ THE EMERGENCY PLANNING BOOKLET ...

	Number	% of Those Who Received Booklet	% of Total Responses
COMPLETELY	82	33	23
PARTIALLY	109	44	30
NOT AT ALL/NEVER RECEIVED BOOKLET	149	18	41
DON'T KNOW/REFUSED	23	5	6

(Based on responses to Questions 9 and 10)

While most respondents knew that warning sirens would be used to signal an accident at Pilgrim, very few knew that they should also tune in to local

television and radio stations to receive more complete information and instructions on what to do (Q. 2, 12). This becomes more significant in light of the fact that the respondents' most common reaction to learning of an accident at Pilgrim would be to evacuate immediately, contradicting the express directions in the emergency information booklet (Q. 11). There is a great danger, therefore, that people will hear the siren and flee without waiting to receive important information and instructions.

Even when evacuation is the right action to take, few of those we surveyed would know where to go. Less than one in five named one of the three evacuation centers specified in the booklet, and of those few who knew where to go, a third did not know the proper route to take (Q. 14, 15). The problem is even more acute for parents of school-age children. Nearly 70% of the parents surveyed would not know where to find their children if an evacuation occurred during school hours. The evacuation plans call for school children to be bused to special reception centers directly from school, but the emergency booklet does not list the locations of those centers.

We also found that the Carver residents we surveyed exhibited a noticeably lower degree of familiarity with emergency procedures than residents of the other three towns within the EPZ. Thirty-six percent of Carver residents, for example, said they had never heard the Pilgrim warning siren (compared to 13% for residents of Plymouth) (Q. 3). Not surprisingly, then, Carver residents were the least likely to be able to distinguish the Pilgrim warning from other warning sirens (Q. 7).

The survey as a whole revealed a general lack of information on the part of the public. But Carver residents also displayed a surprising amount of misinformation about the evacuation plans. Two-thirds of those who said they would go to one of the evacuation centers in case of an accident named the wrong center for their area (Q. 14).

It is clear that Boston Edison needs to make additional efforts to include Carver in warning drills and to counter misinformation about the evacuation plans.

The confusion and panic that could spread from large numbers of people not knowing what to do in a pressure-filled situation might be impossible to quell. But ignorance of the Pilgrim emergency plans is far from the only problem we found.

B. RESIDENTS WILL NOT FOLLOW THE EMERGENCY PLANS

Several survey responses suggest strongly that many people in the EPZ would not follow the procedures outlined in the emergency planning booklet even if they were familiar with them. This finding represents perhaps the most serious challenge to the workability of the Pilgrim emergency plans.

Many recurrent, unsolicited comments made by survey respondents demonstrated a pervasive belief that the emergency plans do not represent a sensible response to a serious accident at Pilgrim. In case of a serious accident, the first thing many respondents would do is "pray" or "kiss my wife" or "panic." Evacuees would head not to one of the emergency reception centers but "whichever way the wind isn't blowing." How will the authorities warn people in case of an accident? A surprising number answered, "What difference does it make?"

The conclusion that EPZ residents would not follow the emergency plans is not based merely on these off-the-cuff remarks. Many of the "hard numbers" point in the same direction. Just 19% of those polled, for example, said they would follow the evacuation plan outlined in the emergency information booklet (Q. 14). While a large part of the reason for this low number could simply be ignorance of the plans (see previous section), only 2% of those answering the same question said that they would go wherever directed, indicating little

willingness to wait for evacuation planners to provide any advice (Q. 14).

The survey also showed that most residents who have children in school in the area will not follow the existing evacuation plans in the event of an accident at Pilgrim. If such a situation were to arise, just 3% of parents said they would wait for their children to come home from school and only 9% would attempt to meet them outside the danger zone, as the emergency booklet advises. Forty-eight percent said they would try to pick their children up from school -- precisely the thing they are not supposed to do. Another 37% did not know what they would do or gave another answer (Q. 18).

Again, only a part of this response is due to ignorance. Even when specifically informed of the proper procedures to follow in case a family member were in school or a hospital during an evacuation, barely over half (51%) of the respondents thought they "would be able" to follow instructions directing them not to try to pick up their family members themselves. Those who gave a reason for for disobeying the instructions typically explained that they simply could not entrust the safety of a family member to the authorities, that this was their responsibility (Q. 22).

TABLE 2

WHAT PARENTS OF SCHOOL-AGE CHILDREN WOULD DO IN CASE OF AN ACCIDENT AT PILGRIM DURING SCHOOL HOURS

	Number	% of Parents With Children in Area Schools
Get children from school	65	48
Wait for them to come home	4	3
*Meet them outside danger zone	13	9
Other	27	20
Don't know	22	17

* Correct answer, according to emergency planning booklet.

(Based on responses to Question 18)

C. THE EMERGENCY PLANS DO NOT ADDRESS THE NEEDS OF MANY POPULATION GROUPS

As the Federal Emergency Management Agency has finally acknowledged, lack of education and widespread distrust are not the only problems with the Pilgrim emergency plans. Our survey revealed that the plans fail to adequately address the needs of families with children, the elderly, and those who have lived in the area for three years or less.

1. FAMILIES WITH CHILDREN

Whether because of the lack of an aggressive public education program or simply because of a poorly designed plan, an attempt to evacuate families with school-age children according to the existing plans will almost surely meet with failure. This constitutes perhaps the most serious flaw in the emergency plans.

More than a third (37%) of the people surveyed have children under 16 who go to school in the Pilgrim area (Q. 16). Few of them would be either willing or able to follow the evacuation procedures outlined in the emergency plans if an accident were to occur during school hours. As noted in section B and Table 2 above, virtually half of parents surveyed (48%) would actually do what the emergency planning booklet tells them not to do -- pick up their children from school themselves.

The evacuation plans are premised on a smooth flow of traffic in a specific direction along the designated routes. A significant portion of the population trying to get to schools all over the EPZ would seriously disrupt planned traffic patterns. Though the evacuation plans call for school children to be transported directly to special evacuation centers, seven out of ten parents we spoke to would not know where to find their children if that happened (Q. 19).

A different set of problems would arise if an accident occurred after

school hours but while many parents were still at work. More than a third of the parents we polled told us that their children are sometimes left unattended after school lets out (Q. 17). According to the emergency booklet, parents away from their homes "may not be permitted to return [to the affected areas] during the evacuation," leaving unknown numbers of children to fend for themselves.

2. THE ELDERLY

Many of the problems we found with the Pilgrim emergency plans are simply exacerbated when dealing with those 65 and older. This group of survey respondents had even less familiarity with the plans than did the general population. More than a fourth did not know that there is an emergency evacuation plan in case of an accident at Pilgrim; few knew that warnings and information would be sent out over local television and radio (Q. 1, 2, 12). And even if they were to hear a warning siren, a third doubted whether they would know what the warning was for (Q. 7).

TABLE 3

FAMILIARITY WITH EMERGENCY PROCEDURES: RESPONDENTS AGE 65 AND OVER COMPARED WITH GENERAL POPULATION

		% of Total Responses	% of Respondents Age 65 and Over
Aware that emergency plans exist for your town?	Yes	87	74
	No	13	26
How will people be warned of Pilgrim accident?	Siren	75	64
	TV/Radio	19	6
	Don't Know	10	14
Could distinguish Pilgrim siren from other sirens?	Yes	59	45
	No	21	29
Know how to get instructions in case of emergency?	TV/Radio	33	19
	Other	9	6
	No	57	72

(Based on responses to Questions 1, 2, 7 and 12)

The elderly also face one problem that most others (aside from children) in the EPZ do not: lack of access to an automobile. At any given time, as many as 12% of those over 65 would not have a car available for their use, compared with two or three percent in the general population (Q. 20). Locating and transporting these people may present a difficult problem for evacuation planners.

3. NEWER RESIDENTS

Those who have lived in the Emergency Planning Zone for three years or less are, in general, the least well informed about emergency planning and about the Pilgrim plant in general. Forty-seven percent of these newer residents, who make up nearly a quarter of all those we surveyed, had not received a copy of the emergency planning booklet (Q. 9). Moreover, only half of them have ever heard the Pilgrim warning siren, compared with more than 80% of the rest of those we surveyed (Q. 3). All the problems associated with ignorance of the emergency procedures discussed above thus apply with even greater force to this large demographic group.

It is unlikely that this problem is the result of apathy on the part of those new to the area. Among new residents who initially thought that the Pilgrim plant should be reopened (Q. 25), more than three-fourths (77%) changed their opinion when informed that the NRC had found serious safety and management problems at the plant, compared to a 54% turnaround among the total sample (Q. 26). This was the largest turnaround we found, strongly suggesting that it is simply lack of information which distinguishes these residents from others. Boston Edison's failure to reach any more than half of these residents with emergency information or warning drills thus could be a primary cause of their inability to cope effectively with an emergency situation.

[illegible]. THE FLAWS REVEALED BY THE SURVEY RENDER THE EMERGENCY PLANS UNWORKABLE

The problems outlined in the preceding three sections reveal significant defects in both the design and implementation of emergency plans for the Pilgrim area. Much of the affected population is unfamiliar with basic elements of the plans, many who are familiar with the plans will not follow them, and the needs of identifiable groups of people have simply not been addressed either in the plans' design or in the dissemination of emergency information.

Our survey uncovered a number of other problems which, combined with those mentioned above, will make an evacuation unworkable.

1. PRESENT WARNING METHODS ARE UNLIKELY TO ALERT RESIDENTS QUICKLY

It seems apparent from our findings that a significant number of residents might not receive effective warning and accurate information quickly enough to be of any use during the short time in which a serious accident could develop.

Use of the warning sirens alone is not enough. Over 40% of those we surveyed said that they could not hear the sirens well or at all when their doors and windows were closed (Q. 4). In addition, many of those who are familiar with the sirens have heard them so often ("every time there is an electrical storm") that simply hearing a siren would not immediately alert them to an actual accident in progress (Q. 3, 6).

2. PHONE LINES ARE LIKELY TO BE TIED UP DURING AN EMERGENCY

Only a third of our survey sample knew that emergency information would be available on local television and radio (Q. 12). It is not surprising, then, that nearly two-thirds of the people we polled said that they would use the telephone to find out emergency information or to find out information about family members (Q. 13). This is particularly understandable in light of the fact that the emergency information booklet contains no instructions against

using the telephone during an emergency.

Thousands of people all picking up the phone at nearly the same time is sure to tie up phone lines and make communication virtually impossible, further hindering an effective response to a serious accident at Pilgrim.

3. ORDERLY EVACUATION IS UNLIKELY TO OCCUR

The obstacles facing those trying to devise a way of evacuating all the residents of the EPZ in case of a serious accident at Pilgrim may well be insurmountable under the best conditions. The problems already discussed above make it abundantly clear that those planning for evacuation now are operating in a situation that is far from ideal.

The lack of familiarity with the existing plans and the lack of confidence that those plans will work are the most obvious problems. Although directed to stay inside and wait for instructions by the emergency information booklet, the initial response to an accident situation among many of those we surveyed included evacuation (27%), making phone calls, packing, and gathering the family (9%, 2%, and 12%, respectively), and a variety of responses subsumed under the categories of "don't know" and "other" (12% and 18%, respectively) (Q. 11). Those who would evacuate, even if properly directed to do so, would flee in all possible directions -- "whichever way the wind isn't blowing," in the words of one respondent -- forsaking the planned escape routes mapped out in the booklet (Q. 14, 15). For many that is not an irrational decision: Hanover Mall, one of the evacuation centers listed in the current emergency information booklet, has withdrawn as an evacuation center!

An intensive program of public education could perhaps overcome some of the flaws identified in the survey. It is uncertain, however, whether education would be enough to convince parents of young children, or people with family members in a hospital or nursing home, to leave their family members to

the authorities for evacuation. The plan simply does not take into account the strong impulse, particularly of parents, to see to the safety of their children themselves (Q. 18, 22).

Finally, the evacuation plan depends primarily on most residents' ability to get themselves out of the danger zone, with emergency workers left to see to any others. Our survey showed that approximately 95% of the people in the EPZ have access to a car at any given time (Q. 20). The effect of nearly every automobile in the towns of Plymouth, Carver, Kingston and Duxbury taking to the roads at the same time is unprecedented and almost unimaginable. Add to that number the residents of the area surrounding the Pilgrim EPZ. During the Three Mile Island emergency, for example, when authorities ordered 2,500 women and young children to evacuate 144,000 people took to the roads.

One respondent commented that it is virtually impossible to get through traffic when there is a snowstorm and a few cars break down; he could not conceive of the problems that would ensue if the entire town of Plymouth tried to leave at once. Most Massachusetts residents are familiar with the monumental traffic problems caused by Cape Cod traffic on a summer weekend. Snarls such as these would almost certainly be dwarfed by those resulting from a full-scale evacuation of the Pilgrim EPZ.

The number of cars on the road would also make it far more difficult for emergency workers and buses to get through to the school children and elderly who cannot transport themselves out of town. Ironically, the widespread availability of cars might prove the greatest obstacle to getting people out of the danger zone in time to protect them from a radiation release.

E. MOST RESIDENTS SURVEYED WANT PILGRIM TO REMAIN SHUT DOWN

In light of the serious problems which beset the emergency plans and the poor safety record compiled by the Pilgrim plant, the residents surveyed have arrived at the following response to this situation: keep the plant shut down.

When asked simply whether they favored reopening the plant after its scheduled maintenance and refueling, 55% said that it should remain shut down and only 34% favored reopening (Q. 25). When those who had not answered "shut down" were informed that the NRC had found serious management and safety problems at the Pilgrim plant, more than half changed their answer and said that if those findings were correct, the plant should remain shut down.

Combining the responses to these two questions, 79% of the entire survey sample favored shutdown in response to either Question 25 or 26, with just 17% still favoring operation of the plant after being asked both questions. Significantly, this response held true across all political and demographic categories: liberals and conservatives, young and old, high-school- and college-educated people, residents of all four towns, and even households containing Boston Edison employees favored shutdown of Pilgrim (Q. 25 & 26: Combined Answer).

Thus, a clear majority of Pilgrim-area residents already favor shutdown of the Pilgrim nuclear power plant. After learning more about official views of the plant's safety, they favor shutdown by nearly a five to one margin.

Much of this sentiment can be attributed to lack of faith in Boston Edison. When asked who they would trust for information and advice during an emergency, our survey sample expressed the greatest distrust for Boston Edison officials. Thirty-one percent said they would have no confidence in their advice; the next highest negative rating was 17%. Boston Edison also had the second-lowest positive rating (coming in just ahead of the faceless "independent expert") and the lowest overall confidence score (Q. 23).

III. DETAILED SUMMARY OF QUESTIONS AND RESPONSES

A. METHODOLOGY

The survey is based on 363 telephone interviews with adult residents of the towns of Plymouth (including Manomet), Carver, Duxbury and Kingston. These towns comprise the emergency planning zone for the Pilgrim Nuclear Power Station.

The questionnaire consisted of 34 questions, including eight questions on demographic variables. Interviewing was conducted from May 5 to May 14, 1987, by MASSPIRG researchers acting under the supervision of a John F. Kennedy School of Government graduate student trained in scientific polling methods.

Telephone numbers for interviews were chosen randomly by computer in order to reach residents with unlisted phone numbers and new residents whose numbers had not yet been published. This technique yields a more representative sample of households than use of a telephone directory to generate numbers.

The survey was a stratified random sample. This technique divides the total population into twelve groups, known as strata, each of which consists of men or women of a given town or telephone exchange. Within each of these strata, individual respondents were selected totally at random. The number of interviews conducted in a given stratum was determined in advance, according to the proportion of the total actual population represented by that group and in order to produce a statistically significant sample from each town. The results were then weighted based on the share of actual population represented by each stratum; the totals thus reflect the distribution by town and gender of the actual population, not of the sample population.

In theory, 95 times out of 100 the results from the overall sample should differ no more than 4 percentage points from what would have been found by surveying the entire population of the towns. The sampling error for smaller

subgroups (for example, a particular age group, or residents of one of the towns) could be larger, depending on the size of these groups. Other errors can result from the usual practical problems of conducting a public opinion survey.

B. THE SURVEY

Question 1. DID YOU KNOW THAT THE STATE AND LOCAL GOVERNMENT HAVE DEVELOPED AN EMERGENCY EVACUATION PLAN FOR YOUR TOWN IN THE EVENT OF A SERIOUS ACCIDENT AT THE PILGRIM NUCLEAR POWER STATION?

	Total Responses		Kingston		Age 65 and Over	
	Number	%	Number	%	Number	%
Yes	314	87	37	80	40	74
No	49	13	10	20	14	26

This threshold question revealed that most respondents were aware of the existence of emergency planning for their community. In Kingston, however, 20% of those surveyed did not know that there is an emergency evacuation plan for their town, and among respondents who are 65 and older, more than one-fourth answered "no" to this question.

Question 2. IF THERE WERE A SERIOUS ACCIDENT AT THE PILGRIM NUCLEAR POWER PLANT HOW DO YOU THINK THE AUTHORITIES WILL WARN PEOPLE? (list all responses)

	Number	% of Total Responses
Siren	272	75
TV / Radio	70	19
Other	34	9
Don't Know	38	10

The correct answer, presented on page 1 of the official emergency planning booklet, is that warnings will go out via civil defense sirens, police loudspeakers, and local radio and television stations. While three-fourths of the respondents named sirens as one warning mechanism, fewer than one in five were aware that warnings would be issued over television and radio. Again,

those over 65 displayed the least awareness of emergency procedures (only 64% mentioned warning sirens, just 6% named TV/radio, and 14% did not know how they would be warned).

Question 3. HAVE YOU EVER HEARD THE PILGRIM WARNING SIREN?

	Number	% of Total Responses
Yes	286	79
No	72	20
Don't Know	3	1

Of those responding "yes" to the question, 42% (120) said they have heard the siren once or twice, 29% (82) have heard it 3 to 5 times, and 17% (48) have heard it go off more than 5 times. Twelve percent (36) did not say how many times they had heard the siren.

More than a third of the Carver residents surveyed (36%) had never heard the warning siren, while 86% of Plymouth residents reported having heard it at least once. Those living in the area for 3 years or less are least likely to have heard the siren -- only 50% of those surveyed answered "yes."

Question 4. HOW WELL CAN YOU HEAR THE PILGRIM WARNING SIREN AT YOUR HOME WHEN THE WINDOWS AND DOORS ARE CLOSED?

	Number	% of "Yes" to Q. 3
Well	95	33
Somewhat well	37	13
Not well	75	26
Not at all	44	15
Don't Know	40	14

Only 46% of those who had heard the siren said that they could hear it well or somewhat well when the doors and windows of their homes were closed, demonstrating the need for additional ways of warning residents in case of an emergency.

Question 5. CAN YOU HEAR POLICE, FIRE OR AMBULANCE SIRENS AT YOUR HOME WHEN YOUR WINDOWS AND DOORS ARE CLOSED?

	Number	% of Total Responses
Yes	273	75
Sometimes	49	13
No	36	10
Don't Know	1	0

Question 6. WHAT DOES IT MEAN WHEN THE PILGRIM SIREN GOES OFF?

	Number	% of Total Responses
Accident	109	30
Drill	70	19
Other	118	33
Don't Know	77	21

"Other" answers included many "evacuate," "head for the hills," "start packing," and "kiss your ass goodbye," indicating that respondents would think an accident was in progress at the Pilgrim plant. (The frivolousness or sarcasm in some of these responses indicates that many residents either do not take the sirens seriously or do not believe warnings would be of any use were a serious accident to occur.) Another group of "other" answers, such as "another thunderstorm," indicated the belief that hearing the siren simply means the warning equipment is malfunctioning.

Question 7. IF YOU HEARD A SIREN RIGHT NOW, DO YOU THINK YOU COULD TELL THAT IT WAS BECAUSE OF PILGRIM, RATHER THAN, SAY, A FIRE ENGINE, AN AMBULANCE, OR SOMETHING ELSE?

	Number	% of Total Responses
Yes, could tell	215	59
Probably could	35	10
Probably could not	11	3
No, couldn't tell	77	21
Don't know	15	4

Again, Carver residents exhibited the least amount of familiarity with the Pilgrim warning sirens: nearly half -- 45% -- answered that they could not or probably could not distinguish the Pilgrim siren from a fire engine or an ambulance. Also, one-third of respondents aged 65 and over expressed doubt that they could recognize the Pilgrim siren.

Question 8. HOW WOULD YOU RECOGNIZE THAT A SIREN MEANT A NUCLEAR ACCIDENT?

	Number	% of Those Answering Q. 7 Affirmatively
High pitch	25	10
Steady tone	26	10
Very loud	42	16
Persistent	30	11
Other	91	35
Don't know	61	23

Although a majority of respondents answered that they would recognize the Pilgrim siren if they heard it (Q. 7), few respondents correctly explained how they would tell whether a real accident were taking place. The nuclear warning siren will be distinguishable from others by its duration (15 minutes), or its "persistence." Only 11% of respondents gave this answer. The most common responses of those categorized under "other" were that the siren has a "fluctuating" or "pulsating" tone, or simply that "you could just tell."

Question 9. HAVE YOU OR ANYONE IN YOUR HOUSEHOLD RECEIVED A COPY OF THE BOOKLET CALLED "EMERGENCY PUBLIC INFORMATION: WHAT TO DO IN CASE OF AN EMERGENCY AT PILGRIM NUCLEAR POWER STATION"?

	Total Responses		New Residents (<3 yrs)	
	Number	%	Number	%
Yes	203	56	33	41
Not sure / maybe	42	11	6	7
No	104	29	39	47
Don't know	11	3	4	4

Although Boston Edison claims to have distributed copies of this booklet to all residents of the emergency planning zone in November 1986, nearly one-third of those we surveyed (29%) had not received a copy, and another 11% were not sure if they had received one. These distribution problems were most critical with regard to people living in the area for 3 years or less, who made up nearly a quarter of the survey sample: 47% of these respondents had not received the emergency planning booklet, compared to only 41% who were sure they had.

Question 10. WOULD YOU SAY YOU HAVE READ THE BOOKLET COMPLETELY, PARTIALLY, OR NOT AT ALL?

	Number	% of "Yes" or "Maybe" to Q. 9	% of Total Responses
Completely	82	33	23
Partially	109	44	30
Not at all	45	18	*

Among those who said they had received or may have received the emergency planning booklet, a full 62% admitted that they had read it only partially or not at all. In other words, only 23% of the total surveyed said they had read the booklet completely. The lack of actual knowledge of emergency procedures that this implies is corroborated by the answers to many other questions in this survey.

* The number who have not read the booklet is actually much larger than 45, since this question was not asked of those who never received the booklet.

Question 11. IN CASE YOU HEAR THE WARNING SIREN, INDICATING A SERIOUS PROBLEM AT PILGRIM, WHAT IS THE VERY FIRST THING THAT YOU WOULD DO?

	Number	% of Total Responses
Turn on radio or TV	65	18
Take shelter at home	37	10
Get family together	42	12
Make phone calls	32	9
Start packing	9	2
Evacuate	99	27
Other*	66	18
Don't know	42	12

* Common responses include:

"Panic" (5 respondents)
"Pray" (6)
"Kiss my wife/husband" (2)
"Get drunk/grab a six" (6)

This question was designed to find out what people would in fact do, as opposed to what they think they are supposed to do. Only 10% said that they would take

shelter at home, as the emergency planning booklet directs on page 3; only 18% said they would turn on the radio or TV to get information or instructions, which the booklet also recommends (there is a degree of overlap in these figures, as some respondents gave more than one answer).

Significantly, the most frequently named response was "evacuate," and a number of other responses -- such as "start packing" and many responses categorized under "other" -- were premised on immediate evacuation, contradicting the express directions in the emergency planning booklet.

Question 12. DO YOU KNOW WHAT THE OFFICIAL EMERGENCY PLAN RECOMMENDS THAT YOU DO TO GET SPECIFIC INSTRUCTIONS IN CASE OF AN EMERGENCY?

	Number	% of Total Responses
Yes: turn on radio/TV	120	33
Yes: other	31	9
No	206	57

Only one in three respondents knew the correct response, "tune to local radio and TV stations," which is listed on page 3 of the emergency information booklet. Even more disturbing, fewer than one in five respondents 65 or over (19%) gave the correct response to this question, reiterating the concern that the elderly may present difficult problems for emergency planners.

Question 13. WOULD YOU USE THE TELEPHONE TO FIND OUT EMERGENCY INFORMATION OR TO FIND OUT INFORMATION ABOUT FAMILY MEMBERS?

	Number	% of Total Responses
Yes	226	62
No	117	32
Don't know	16	4

Surprisingly, the emergency information booklet does not advise people not to use the telephone in case of an emergency. Accordingly, nearly two-thirds of those we surveyed said that they would use the phone -- primarily to call the police for information or to try to contact family members. In all likelihood, this will only serve to tie up phone lines and jeopardize efficient execution of the emergency plans.

Question 14. IF THERE WERE AN ACCIDENT AT PILGRIM AND YOU WERE TO ACTUALLY EVACUATE YOUR HOME, WHERE WOULD YOU GO?

	Number	% of Total Responses
Hanover Mall	46	13
Bridgewater State College	20	5
Taunton State Hospital	3	1
Elsewhere in Mass.	91	25
Wherever directed	7	2
Other*	119	33
Don't know	65	18

* Representative responses include:

"Whichever way the wind isn't blowing"
"Roads would be jammed up/would never get out of town"
"Alaska/Canada/California/Vermont/Mississippi"
"Good question!"

Only 19% of the respondents said they would go to one of the evacuation centers named in the emergency information booklet (the first three responses listed above). Two-thirds of these people (13%) would go to the Hanover Mall, which has already pulled out of the evacuation plan and will not serve as a reception center, but which is still listed as one in the booklet.

It is clear from these responses that a real evacuation would produce chaos. Only 2% of those surveyed would listen first for directions, confirming the conclusion suggested by Question 12 that few people would know to wait and tune in to local media for emergency information. Moreover, many of those who profess knowledge of the actual plans are misinformed: for example, two-thirds of the Carver residents who said they would go to an evacuation center named the wrong one.

Even those supposedly "in the know" evidenced a shocking lack of confidence in the evacuation plans. Although the sample size is admittedly very small, only 2 of 15 respondents from households containing Boston Edison employees and only 4 of 20 from households containing someone responsible for implementing the evacuation plans said they would go to one of the evacuation centers in case of an accident at Pilgrim.

Question 15. DO YOU KNOW WHAT ROUTE YOU ARE SUPPOSED TO TAKE TO GET THERE [TO THE EVACUATION CENTER]?

	Number	% of Those Who Said They Would Go To an Evacuation Center
Yes	43	62
No	23	34

This question tested the knowledge of the evacuation routes mapped out in the emergency information booklet (pp. 4-5) among those respondents who said, in response to Question 14, that in case of an emergency they would go to one of the evacuation centers. Even among this self-selected group, one-third admitted that they did not know the recommended route.

Question 16. DO YOU HAVE ANY CHILDREN AGE 16 OR YOUNGER WHO GO TO SCHOOL IN THE AREA?

	Number	% of Total Responses
Yes	134	37
No	226	62

Question 17. ARE THERE ANY TIMES AFTER SCHOOL HOURS WHEN YOUR CHILD(REN) IS(ARE) NOT IN THE CARE OF AN ADULT?

	Number	% of "Yes" to Q. 16
No	83	62
Yes	50	37

In case of an emergency at Pilgrim during after-school hours, as many as 37% of children 16 or under could be left to fend for themselves. Parents at work during these times "may not be permitted to return [to the affected areas] during the evacuation," according to the emergency information booklet (p. 6).

Question 18. IF THERE IS AN ACCIDENT AT PILGRIM DURING SCHOOL HOURS, WHAT WOULD YOU DO ABOUT YOUR CHILD(REN)?

	Number	% of "Yes" to Q. 16
Get children from school	65	48
Wait for them to come home	4	3
Meet them outside danger zone	13	9
Other	27	20
Don't know	22	17

The correct answer, "meet them outside the danger zone," was given by only 9% of the respondents. The most common response was to go get the children from school oneself, which people are explicitly instructed not to do on page 6 of the emergency planning booklet. The response to this question clearly indicates either a major flaw in the evacuation plans or the need for intensive education to convince parents to ignore their strong impulse to find their children themselves.

Question 19. ACCORDING TO THE OFFICIAL EMERGENCY PLAN, YOU ARE SUPPOSED TO MEET THEM AT A SPECIAL EVACUATION CENTER AWAY FROM TOWN. DO YOU HAPPEN TO KNOW WHERE THE CENTER IS WHERE YOU WOULD FIND YOUR CHILD(REN)?

	Number	% of "Yes" to Q. 16
Yes	39	29
No	92	69

Adding to the confusion and panic that an evacuation would cause, seven out of ten parents we surveyed would not know where to find their children if an accident occurred at Pilgrim during school hours.

Question 20. DO YOU HAVE A CAR AVAILABLE FOR YOUR USE DURING ...

	Total Responses		Age 65 & Over	
	Number	%	Number	%
... WEEKDAYS?				
Yes	344	95	49	90
No	11	3	5	10
Sometimes	5	2	0	0
... WEEKNIGHTS?				
Yes	340	94	47	88
No	13	3	6	12
Sometimes	4	1	0	0
... WEEKENDS?				
Yes	343	94	49	90
No	9	2	4	7
Sometimes	4	1	1	2

At any given time, 95% of the households in the emergency planning zone would have a car available to be used. This many households each evacuating in a separate automobile at the same time will likely create traffic problems of unprecedented proportions, particularly in light of the fact that most people surveyed would not know to use the evacuation route planned for their particular section of the EPZ (see questions 14 and 15).

Respondents 65 and over were the only demographic group without such wide access to an automobile. 7 to 12% of those we surveyed would not be able to

use a car at any given time, creating a different set of problems for evacuating this group of residents.

Question 21. DOES YOUR HOME HAVE A BASEMENT?

	Number	% of Total Responses
Yes	313	86
No	47	13

Question 22. SUPPOSE YOU WERE ADVISED TO EVACUATE BECAUSE OF AN ACCIDENT AT PILGRIM, BUT YOU HAD CHILDREN IN SCHOOL OR A FAMILY MEMBER IN A HOSPITAL OR NURSING HOME. ACCORDING TO THE PLAN, YOU ARE SUPPOSED TO GO DIRECTLY TO A SPECIAL EVACUATION CENTER, WHILE YOUR FAMILY MEMBERS WERE TRANSPORTED TO THEIR APPROPRIATE LOCATIONS. WOULD YOU BE ABLE TO FOLLOW THESE INSTRUCTIONS?

	Number	% of Total Responses
Yes	185	51
No	128	35
Don't know	42	12

This question is similar to the one asked of parents of school-age children (Question 18), but is far less open-ended and more likely to elicit a "yes" response. First, the question is hypothetical -- most respondents did not in fact have children in school or family members in a hospital or nursing home. Second, the question spells out what the actual evacuation plans are in a way that makes them sound reasonable and workable. Finally, the question asks whether the respondent "would be able" to comply with such a scheme if instructed to do so.

In spite of the clear slant of this question, nearly half those surveyed said that they either would not follow these plans or did not know whether they could follow them. The vast majority of those answering "no" mentioned their need to provide for the safety of their family members themselves and not to entrust that role to the authorities. As was clear with Question 18, the strong desire of people to find their family members indicates either a major flaw in the evacuation plans or the need for far better education on behalf of Boston Edison.

Question 23. IF THERE WERE AN ACCIDENT AT PILGRIM, YOU MIGHT HEAR STATEMENTS ON THE RADIO OR ON TV [illegible] DIFFERENT PEOPLE AND ORGANIZATIONS. I'M GOING TO MENTION SOME OF THEM, AND AS I DO, PLEASE TELL ME FOR EACH ONE HOW MUCH CONFIDENCE YOU WOULD HAVE IN THEM TO GIVE YOU ACCURATE INFORMATION AND GOOD ADVICE. A SCORE OF 5 MEANS THAT YOU HAVE A GREAT DEAL OF CONFIDENCE IN THEM; A SCORE OF 1 MEANS THAT YOU HAVE NO CONFIDENCE IN THEIR ADVICE; A SCORE OF 3 WOULD BE SOMEWHERE IN THE MIDDLE.

	% of Total Answering ...						Average
	"5"	"4"	"3"	"2"	"1"	DK	Score*a
Governor Dukakis	36	[illegible]	[illegible]	6	17	2	3.54
An official of Boston Edison	19	[illegible]	[illegible]	[illegible]	31	2	2.81
An official of the U.S. Nuclear Regulatory Comm.	34	[illegible]	21	6	16	3	3.51
Attorney General Shannon	19	[illegible]	[illegible]	3	12	18	3.30
An independent expert	15	[illegible]	[illegible]	[illegible]	17	10	3.01

Boston Edison received easily the [illegible] of any of the people or organizations we mentioned, garnering the second-lowest positive rating, far and away the highest negative rating and the lowest average score. Even among those respondents who believe that Pilgrim should reopen despite findings of serious safety problems (see Questions 25 and 26), only 32% expressed a great deal of confidence in emergency information disseminated by Boston Edison.

* "Average Score" was computed excluding those answering "don't know" or who refused to answer. Thus, Attorney General Shannon's 3.30 score must be tempered by the fact that 18% did not know what amount of confidence they would have in him.

Question 24. DO YOU THINK THAT IT IS LIKELY THAT THERE WILL BE A SERIOUS ACCIDENT AT THE PILGRIM PLANT?

	Number	% of Total Responses
Yes	[illegible]	24
Maybe	[illegible]	20
No	[illegible]	[illegible]
Don't know	31	9

Nearly half -- 44% -- of those s[illegible] that a serious accident at Pilgrim is either likely or at least possible. This viewpoint held true across the political spectrum: [illegible] self-described conservatives, 44% of

liberals, and 51% of moderates answered either "yes" or "maybe" to this question.

Interestingly, of those who believed that Pilgrim should not be reopened (see Questions 25 and 26), only 53% thought a serious accident is likely or may be likely. This total is just slightly larger than the total sample's response to Question 24, suggesting that opposition to Pilgrim runs deeper than simply fear of a serious accident. Other issues that may be generating public dissatisfaction with the Pilgrim plant probably include waste disposal, smaller scale radiation releases, and unreliability.

Question 25. PILGRIM IS CURRENTLY SHUT DOWN FOR MAINTENANCE AND REFUELING. IN YOUR OPINION, SHOULD THE PLANT BE REOPENED OR SHOULD IT REMAIN SHUT DOWN?

	Number	% of Total Responses
Reopened	123	34
Shut Down	200	55
Other	15	4
Don't Know	24	7

Over half of those polled want Pilgrim to remain shut down, while only a third believe the plant should reopen. As with the responses to Question 24, this sentiment cut across political lines: 51% of conservatives, 60% of liberals, and 59% of moderates favored shutdown.

An interesting footnote to these figures was the response of people from households with either a Boston Edison employee or someone responsible for implementing the emergency plans (15 and 20 respondents, respectively). While these figures are not statistically significant, it is nevertheless noteworthy that a fifth of the respondents from each of these groups favored unequivocal shutdown of the Pilgrim plant.

Question 26. STUDIES RECENTLY COMPLETED BY THE U.S. NUCLEAR REGULATORY COMMISSION SHOW INDICATIONS OF MANAGEMENT AND SAFETY PROBLEMS AT PILGRIM, MAKING IT ONE OF THE MOST DANGEROUS NUCLEAR PLANTS IN THE COUNTRY. IF THESE FINDINGS ARE CORRECT, IN YOUR OPINION SHOULD THE PLANT BE REOPENED OR SHOULD IT REMAIN SHUT DOWN?

	Number	% of Non-"Shut Down" Responses to Q. 25
Reopened	60	37
Shut Down	88	54
Other	5	3
Don't Know	5	3

This question, asked only of those not answering "shut down" to Question 25, is obviously a more loaded question and for that reason was the last question asked in the survey, so as not to taint the other responses. Only slightly more than a third of those who initially favored reopening Pilgrim still believed the plant should reopen in light of the NRC's findings regarding safety and management problems. The turnaround was most dramatic among those who had lived in the area for three years or less, a group making up 23% of our total sample. 77% of these respondents answered "shut down" to this question (compared to 54% on Q. 25), suggesting that many newer residents simply are not yet fully informed about the problems that have historically plagued the Pilgrim plant.

Questions 25 and 26: COMBINED ANSWERS

	Number	% of Total Responses
Answered "Shut Down" to Q. 25 or Q. 26	288	79
Answered "Reopen" to Q. 26	60	17

Less than one in five respondents was unequivocally in favor of reopening the Pilgrim plant. The overwhelming sentiment in favor of shutting down an unsafe nuclear power plant was consistent across all demographic lines:

* all four towns in the survey favored shutdown by margins ranging from 74% (Carver) to 90% (Kingston);

* self-described conservatives were 77% in favor of shutdown, compared to 84% for liberals, 82% for moderates, and 72% for those who could not or would not describe their political orientation;

* the only age group coming in at less than 70% was the 65 and over group, 66% of whom favored shutdown;

* educational background also had little effect on shutdown sentiment: the percentages in favor of shutdown varied only between 75 and 83% when the survey sample was grouped by educational level;

* even among those from households containing Boston Edison employees or those with official responsibilities for implementing the emergency plans, respondents favoring shutdown outnumbered those in favor of reopening the plant by approximately 5 to 3.

IV. RECOMMENDATIONS

Our survey of Pilgrim area residents shows a widespread lack of knowledge about emergency planning procedures, little faith among the population that the evacuation plans are workable or worth complying with, strong indications that any attempt at immediate evacuation would meet with little success, and a broad consensus behind the idea that a nuclear plant with a safety record like Pilgrim's should remain shut down. These conclusions are surprising only to the extent that they present an even poorer picture of emergency preparedness than was revealed in the last MASSPIRG survey.

MASSPIRG and a variety of other citizen groups and local and state officials have consistently argued that the Pilgrim emergency plans are themselves a disaster. With the rapid population growth in the Plymouth area and the withdrawal of the Hanover Mall as an evacuation center, the plans have deteriorated even further. FEMA has withdrawn its approval of the plans, calling them "inadequate to protect the public health and safety in the event of an accident." Yet Boston Edison is nonetheless considering restarting the plant without locally and federally approved plans.

The findings in this report clearly demonstrate that restarting the plant under the existing emergency plans could prove disastrous. Given the current level of public information about the plans, they would not be adequate to protect the public health and safety even if the deficiencies identified by FEMA were corrected. Moreover, because residents responded that they would refuse to comply with key elements of the plans, there is a serious question as to whether any plans, no matter how good they looked on paper, could be effectively implemented.

In light of these results and the serious management and safety problems still remaining at Pilgrim, we strongly recommend that the Pilgrim plant should not reopen until it is determined that:

(1) workable plans can be developed;

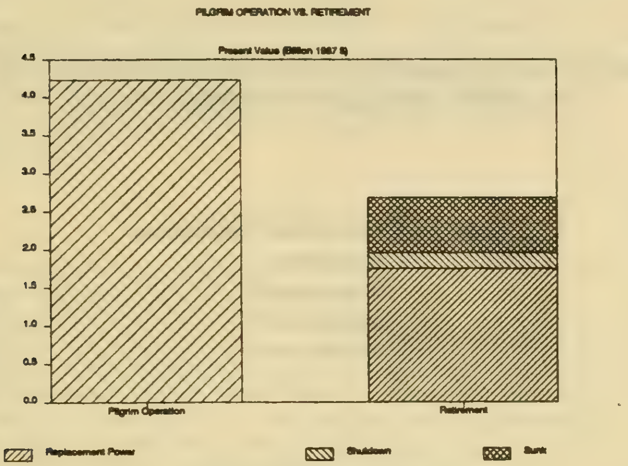
(2) such plans have been effectively implemented and communicated to the public; and,

(3) existing management, safety and economic concerns have been adequately addressed.

We call on Governor Dukakis, the State Legislature, and the Massachusetts congressional delegation to do everything within their power to keep the reactor closed until the above conditions have been met.

In the meantime, MASSPIRG continues to recommend that the State and Boston Edison explore the possibility of alternatives -- such as efficiency reforms, cogeneration, small power producers, and conservation -- which have the potential to produce energy more safely, cheaply and efficiently than does the Pilgrim nuclear power plant.

NUCLEAR LEMON



RATEPAYER SAVINGS FROM RETIRING THE PILGRIM NUCLEAR POWER PLANT

Massachusetts Public Interest Research Group
(MASSPIRG)

NOVEMBER 1987

NUCLEAR LEMON

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Alan Nogee has been an Energy Policy Analyst for over ten years. He is author of two major national reports on utility policy -- *Rate Shock: Confronting the Cost of Nuclear Power,* and *Gambling for Gigabucks: Excess Capacity in the Electric Utility Industry* -- and numerous articles. He has testified or spoken by invitation to the energy committees of the U.S. Senate, House of Representatives, National Governors' Association, National Conference of State Legislatures, and regulatory agencies and legislative committees in several states. Before joining MASSPIRG in May, 1987, he was an Energy Analyst with Environmental Action Foundation, in Washington, D.C., and for consumer and environmental groups in Philadelphia, Pennsylvania.

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EXECUTIVE SUMMARY

This study examines the costs and benefits of permanently closing the Pilgrim nuclear plant, and replacing it with alternatives that are currently available to Boston Edison (BECO). Using conservative assumptions which are likely to underestimate Pilgrim's costs, and to overestimate the cost of alternatives, MASSPIRG has found that:

1. Utility customers would save at least $1.5 billion (present value) over the next 25 years by closing Pilgrim, if future Pilgrim costs were to follow historical trends for the plant. These savings would occur even if ratepayers had to pay for the full utility investment in the plant to date, including the same profit the companies would have earned if the plant had operated.

2. If trends at Pilgrim improved to the most optimistic levels that could reasonably be hoped for, utility customers would still save money by retiring Pilgrim, even if they had to pay for the full sunk investment in the plant.

3. Even under Edison's own assumptions, which are unrealistic, ratepayers would likely benefit from Pilgrim retirement, if the Massachusetts Department of Public Utilities required utility customers and investors to share the cost of past investment in Pilgrim according to traditional regulatory practice.

This study starts with the same figures and uses the same methods of analysis employed by BECO in a recent presentation to the Massachusetts Executive Office of Energy Resources (EOER). The utility's assumptions about future Pilgrim performance and major costs are compared to past performance and cost trends at Pilgrim and other U.S. nuclear plants, and alternative assumptions and cost projections are developed.

In order to err on the side of *underestimating* Pilgrim costs, MASSPIRG uses a number of unrealistically low Edison estimates in all projections. The costs of nuclear fuel, nuclear waste disposal and of dismantling Pilgrim at the end of its operating life are unchanged from BECO projections. It is assumed that the 15-year-old Pilgrim plant could operate for a total of 40 years, although no nuclear plant has operated for longer than 26 years. To be as favorable to Pilgrim as possible, MASSPIRG also assumes that the cost of replacement parts and safety upgrades will level off, and that Pilgrim performance will not deteriorate with age.

Replacement power for Pilgrim is readily available from at least two sources. First, Pilgrim's owners could "mine" electricity that is currently wasted by inefficient lighting, appliances, and other electrical equipment. A report to Edison's Board of Directors indicated the potential to reduce the utility's electric demand by 1,000 megawatts (Mw), at an average cost of less than two cents per kilowatt hour saved. Second, Pilgrim's owners could purchase electricity from small power producers and cogenerators. Independent power producers have bid to supp-

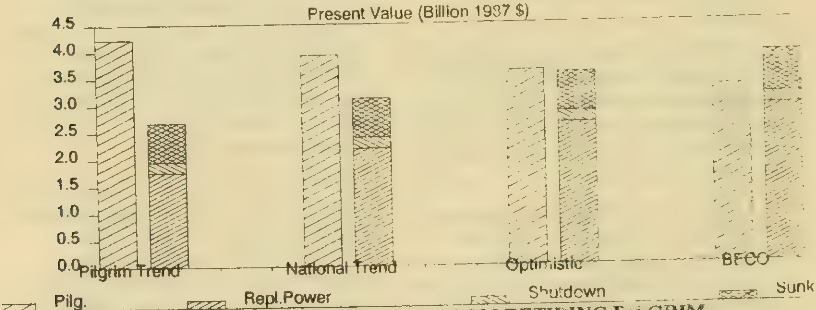
ly Boston Edison with 1,848 Mw by 1992. Pilgrim capacity is 670 Mw.

While some of the independent facilities have environmental problems, the combined potential of the efficiency improvements and independent power producers could replace Pilgrim and meet Edison's projected demand growth with over 1,000 Mw to spare. In order to *over-estimate* the cost of replacing Pilgrim, it is assumed that *all* the efficiency savings go to displace demand growth, with the cost of power to replace Pilgrim based on a range of bids from cogeneration and small power facilities.

The table and figure below summarize the savings to ratepayers from retiring Pilgrim under various assumptions. The "Pilgrim Optimistic Case" (most favorable to Pilgrim) combines the *lowest* reasonable level of Pilgrim costs with the *highest* level of replacement power costs. The "National Trend Case" assumes that the rate of escalating costs at Pilgrim *improves* to the level of the average nuclear plant with Pilgrim's characteristics (age, type, location, etc.), and a moderate level of replacement power costs. The "Pilgrim Historical Trend Case" assumes that Pilgrim costs continue to escalate at their historic rates, and assumes the lowest level of replacement power costs.

All cases show savings to ratepayers from retiring Pilgrim. MASSPIRG therefore recommends that the Pilgrim plant be permanently closed. The Department of Public Utilities should allow no recovery of any future utility investment in the plant.

PILGRIM OPERATION VS. RETIREMENT



SAVINGS TO RATEPAYERS FROM RETIRING PILGRIM

	Ratepayers Pay Sunk Costs	Investors Pay Sunk Costs
Pilgrim Historical Trend Case	\$1.56 billion	\$2.28 billion
National Trend Case	\$813 million	\$1.54 billion
Pilgrim Optimistic Case	\$49 million	\$773 million
BECO	-\$611 million	\$168 million

1. Introduction -- Nuclear Costs and Cancellations

The Pilgrim nuclear power plant, in Plymouth, Massachusetts, is the focus of intense controversy over health and safety issues. (See, for example, *No Exit: The MASSPIRG Survey of Pilgrim Evacuation Planning*, September 1987.) Relatively little attention, however, has been paid to the increasing cost of operating the Pilgrim plant.

When Pilgrim was first turned on in late 1972, it appeared to be a relatively inexpensive source of electric power. Built for $232 million, Pilgrim's construction cost about three times as much per kilowatt of capacity[*] as an oil- fired plant. But uranium fuel was so much cheaper than oil, especially after the oil embargo of 1973, that the total cost of owning and operating the nuclear plant was less.

It is worth noting that some nuclear costs -- such as for research and development, fuel processing and insurance -- were heavily subsidized by federal tax dollars.[1] The Price-Anderson Act, passed by the U.S. Congress in 1957, limited industry liability for nuclear accidents, thereby relieving it of having to consider fully the economic risks of nuclear generation. Other costs -- for disposing of nuclear wastes and dismantling the plant at the end of its operating life (decommissioning) -- could not be reliably estimated then or now, since the required technologies still have not been demonstrated.[2]

During the 1970s, the cost of building new nuclear plants escalated dramatically. Nuclear construction costs increased by over twice the inflation rate, and nearly twice as fast as the cost of building coal-fired plants.[3] Major causes of the increases included technical problems that were identified as nuclear plants gained operating experience, new safety regulations imposed by the Nuclear Regulatory Commission (NRC), and management failures to anticipate and respond adequately to these pressures.[4]

As a result of increasing nuclear construction costs, and a drop in electricity demand growth, many orders for nuclear plants were canceled in the 1970s and 1980s. Over 110 nuclear plants -- almost half of the total number that utilities had ordered -- were canceled in various stages of construction, including a second unit planned for the Pilgrim site.[5]

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[*] Power plant capacity is measured in watts. A kilowatt (Kw) is equal to 1,000 watts, enough power to light ten 100-watt light bulbs. A megawatt (Mw) equals one million watts or 1,000 kilowatts. An amount of electricity generated over a period of time is measured in kilowatt hours. A one megawatt plant operating at full capacity for 1 hour would produce 1,000 kilowatt hours (Kwh) of electricity. Pilgrim's capacity is 670 MW, of which Boston Edison owns 74.27 percent. Other owners are: Commonwealth Electric -- 11 percent, Eastern Utilities -- 10.5 percent, Massachusetts Municipal Wholesale Electric -- 3.73 percent, and Newport Electric -- .5 percent. For simplicity, Pilgrim will be treated in this report as if it were entirely owned by Boston Edison.

The same factors that caused construction costs to skyrocket for new nuclear plants have also increased the costs of older plants. Large expenses have been required for replacement equipment and safety improvements, called "capital additions," and for major repairs. In addition to work needed to bring older plants up to new safety standards, many nuclear parts and systems have worn out sooner than expected.[6] For the U.S. nuclear industry as a whole, capital additions increased by an average of 13 percent a year, after adjusting for inflation, between 1970 and 1986. Operation and maintenance costs increased by an average of over 11 percent a year, after inflation, during the same period. In addition, the majority of nuclear plants failed to perform as reliably as their owners expected, experiencing many more shutdowns than other types of power plants.[7]

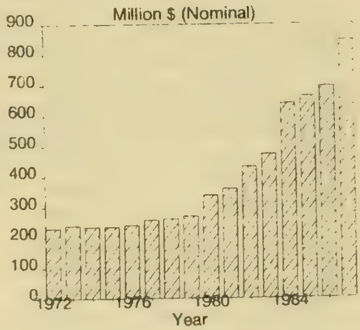
As a result of these increasing capital and operating costs, some utilities have begun to take a hard look at the cost of continuing to operate nuclear plants. In March, 1986, the Washington Public Power Supply System (WPPSS) temporarily closed its two-year-old operating reactor because it was more expensive to operate than oil or gas-fired plants.[8] In May, 1987, the Dairyland Power Cooperative, in Wisconsin, permanently shut down its 18-year-old LaCrosse nuclear plant because it was no longer competitive with alternatives.[9]

The Pilgrim nuclear plant has been subject to the same cost trends as other nuclear plants. **In fact, between 1980 and 1985, Pilgrim had the second most expensive capital additions per kilowatt of any nuclear U.S. power plant, and has become one of the most expensive nuclear plants in the country.**[10] By the end of 1987, Boston Edison (BECO) will have sunk $614 million into Pilgrim *above* its $232 million original cost, bringing the total investment in the plant to $846 million (Figure 1). Even after adjusting for inflation, Boston Edison has spent 40 percent more for replacement and new parts for Pilgrim than it initially spent building the plant.

Largely as a result of these capital additions, Boston Edison's own estimates show that in 1988, electricity

Figure 1

PILGRIM CAPITAL COST

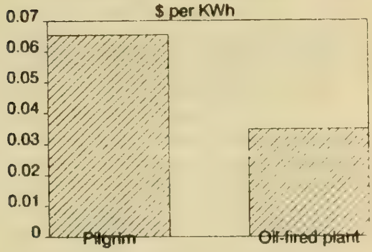


from Pilgrim will cost 6.53 cents per Kwh, almost twice as much as power from oil-fired plants, at a cost of 3.34 cents per Kwh (Figure 2).

BECO also recognizes that continued Pilgrim operation will require ongoing capital additions. **Edison estimates that keeping Pilgrim running will require another $1.4 billion investment in capital additions over the 25 years it estimates for Pilgrim's remaining life. Pilgrim's total capital cost would then equal over $2.25 billion dollars -- almost ten times the initial construction cost of the plant (Figure 3).** Moreover, independent estimates discussed in the following chapters of this

Figure 2

ELECTRICITY GENERATION COST -- 1988

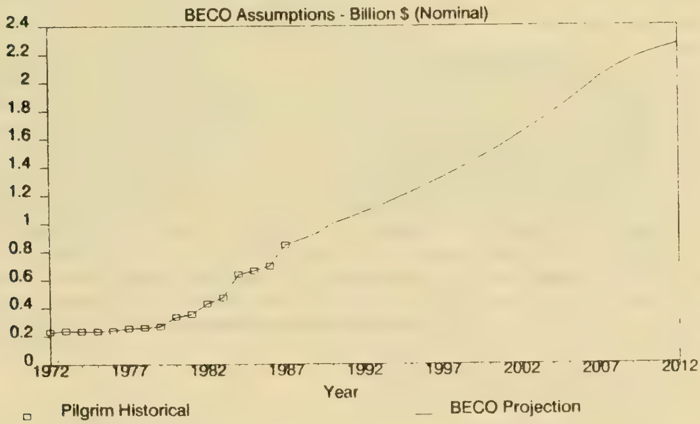


report indicate that capital additions and other costs are actually likely to exceed BECO estimates. These escalating costs require serious consideration of whether continued investment in and operation of Pilgrim is economical.

In April, 1986, the Pilgrim plant experienced two "unexplainable automatic shutdowns," or "scrams." The NRC ordered the plant to remain closed until serious problems with Pilgrim and its management are resolved. During this time, Boston Edison has chosen to make major upgrades in the Pilgrim plant -- budgeting over $150 million in capital additions and nearly $100 million in maintenance costs in 1987 -- to return the Pilgrim plant to service. This study looks at whether it makes more economic sense to retire Pilgrim than to continue investing hundreds of millions of dollars in it. Chapter 2 looks at Boston Edison's projections of Pilgrim costs, compares BECO assumptions about nuclear cost trends to the historical trends at Pilgrim and other nuclear plants around the country, and develops more realistic estimates of future Pilgrim costs. Chapter 3 examines the cost of retiring the Pilgrim plant and replacing it with alternatives currently available to Boston Edison. Chapter 4 summarizes the report's overall findings and presents MASSPIRG's recommendations.

Figure 3

PILGRIM CAPITAL COST PROJECTION



2. The High Cost of Operating Pilgrim

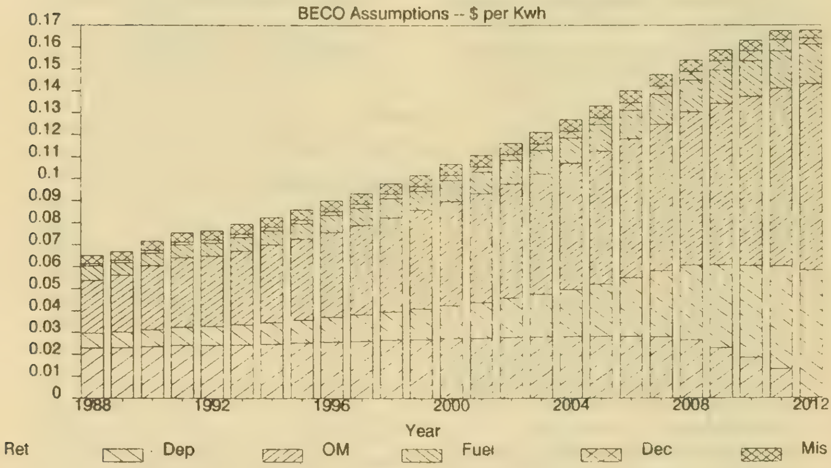
A. Boston Edison projections

In May, 1987, Boston Edison developed projections of Pilgrim's future costs in response to a request by the Massachusetts Executive Office of Energy Resources (EOER). Edison's projections were also sent to the Office of the Attorney General, the Department of Public Utilities, and upon request, to MASSPIRG.

BECO projects that the cost of electricity from the Pilgrim plant will increase from 6.53 cents per kilowatt hour (Kwh) in 1988 to 16.76 cents per Kwh in 2012 (Figure 4), primarily as the result of inflation. Another way of looking at the cost of Pilgrim is to add up the total bill to ratepayers for the plant's costs over the remainder of its expected life. The "present value" of BECO's estimate of future Pilgrim costs (discounting future dollars at the 10.55 percent annual rate Edison uses to account for the declining value of money over time) is $3.3 billion in 1987 dollars.

Figure 4

PILGRIM COST COMPONENTS



(See next page for explanation.)

How Pilgrim Costs Are Calculated

The graph on the opposite page shows how much Boston Edison expects to charge its customers each year for electricity from Pilgrim, based on the standard rules of utility regulation. Electric companies are allowed to recover most operating and fuel expenses directly in rates as they are incurred each year. Utility investment in major plant and equipment is recovered over the operating life of the plant through depreciation charges. Utilities are also allowed to charge customers for their financing costs, including a profit on their investment.

The bottom section of each bar in the graph shows the financing charges, or return, that BECO expects to earn on its Pilgrim investment. The return consists of interest payments on debt borrowed to finance Pilgrim, and the profits BECO expects regulators to allow it to earn on its investment in the plant. The next area up represents depreciation of BECO's Pilgrim investment. The third area from the bottom depicts operation and maintenance (O&M) charges, which include labor and direct operating expenses. Above O&M are the costs for nuclear fuel, including current estimates of waste disposal costs. The next area of the graph shows how much money is collected to pay for decommissioning the plant at the end of its operating life. The top area indicates miscellaneous expenses, such as insurance and local property taxes.

BECO expects to earn a 14.4 percent rate of return on its Pilgrim investment. About 38 percent of that amount is paid to the federal government for income taxes. Every billion dollars invested in Pilgrim thus translates into $144 million in charges per year in rates. Each year, 1/40 of the investment in Pilgrim is charged to ratepayers for depreciation, and that amount is subtracted from the next year's "rate base," an account in the utility's books representing the amount of investment on which the utility can earn a return. The current fee for waste disposal assessed by the Department of Energy is one-tenth of a cent per KWh. Decommissioning cost charges are calculated to accumulate the $126 million (in 1986 dollars) Edison estimates will be necessary to dismantle the nuclear plant in the year 2012. Property taxes average about 1.8 percent of the value of the plant in rate base. Insurance costs increase over time from $5-15 million a year.

The cost per kilowatt hour is calculated by dividing the total annual cost by the number of Kwh generated per year. KWh per year is a function of capacity factor (see Chapter 3, Section B) multiplied by 8760 hours per year times the 670,000 kilowatt size of the plant. Edison assumes a 70 percent capacity factor for future Pilgrim operation.

But based on historic nuclear cost trends, Edison is greatly underestimating Pilgrim costs. Projecting the total cost of electricity from a power plant involves making numerous assumptions about various cost components, as well as the overall operating performance of the plant. Three assumptions in particular dominate the final results: the rate of capital additions, operation and maintenance (O&M) expenses, and the amount of time the plant can be expected to operate (capacity factor).

B. MASSPIRG projections

MASSPIRG has compared Edison assumptions in each of these areas to actual performance and cost trends at Pilgrim and other nuclear plants around the country. The specific results of these comparisons are presented in Appendix B. In general, Edison projections assume that the past performance of Pilgrim and other nuclear plants provide *no guide* to future costs. Consistent historical trends -- both at Pilgrim and at nuclear plants around the

country -- are assumed to immediately stop.

O&M costs, which have increased nationally by 11.4 per year, after adjusting for inflation, and by 13.8 percent annually at Pilgrim, are projected to increase at only 0.5 percent per year henceforth. Capital additions, which have escalated nationally at 13 percent per year after inflation, and much faster at Pilgrim, are also forecast by Edison to increase by 0.5 percent per year in the future. Despite the fact that Pilgrim has had a lifetime capacity factor of only 50 percent, and the national average for nuclear plants is 60 percent, Edison predicts that Pilgrim will average a 70 percent capacity factor in the future.

Nuclear utilities around the country have been making similar assumptions for many years. Each year, the utilities project that nuclear costs will freeze at then-current levels. Instead, real costs have continued to rise. The basic forces that have run up nuclear costs in the past will continue to increase costs in the future. These factors include technical problems discovered as nuclear plants gain more operating experience, unresolved generic nuclear safety issues, the aging of reactor parts, and the potential for both small and large nuclear accidents to create new regulatory requirements.[11] (See Appendix C for additional discussion.)

It is therefore important to examine more realistic assumptions for nuclear costs. MASSPIRG looks at three alternative assumptions for each major nuclear cost component. In a "Pilgrim Historical Case," future costs are assumed to continue to escalate in line with historical trends for the Pilgrim plant. In a "National Trend Case," Pilgrim cost trends are predicted to improve to match those of the average plant having Pilgrim's characteristics. For a "Pilgrim Optimistic Case," it is assumed that future Pilgrim costs will improve to a level substantially better than would be expected based on either Pilgrim or national trends.

The detailed basis of MASSPIRG's alternative projections are presented in Appendix B. Figures 5 and 6 illustrate the effect of the revised assumptions on the annual cost per Kwh and on the total present value of Pilgrim costs to

Figure 5

PILGRIM ANNUAL GENERATION COSTS

Alternative Scenario Analysis

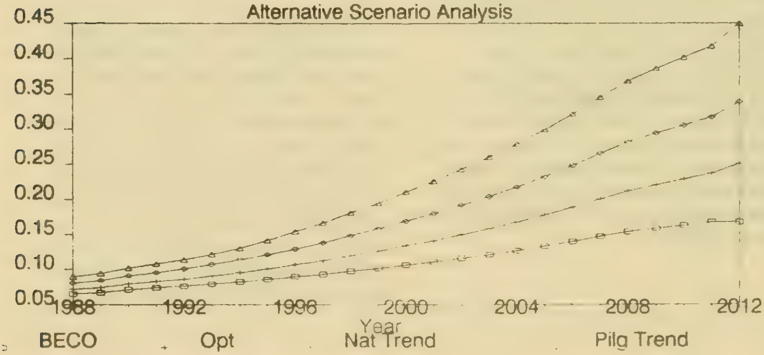
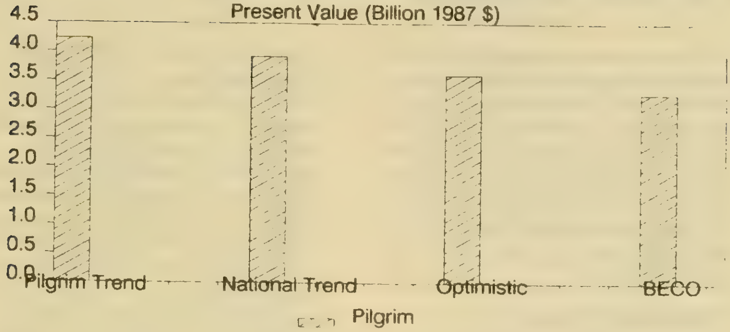


Figure 6

RANGE OF PILGRIM TOTAL COSTS

Present Value (Billion 1987 $)



ratepayers, respectively.

All three MASSPIRG cases share a number of *extremely* conservative assumptions. In general, nuclear costs are assumed to be increasing according to linear trends (i.e., a constant number of dollars per year, after adjusting for inflation) rather than according to exponential trends (i.e., a constant percentage increase per year, after inflation). The trend of increasing capital additions is still assumed to level off in a few years, despite evidence that it may actually be accelerating. Plant performance is not assumed to deteriorate with age, despite evidence of declining capacity factors, particularly at salt-water-cooled plants like Pilgrim.

For simplicity, and to be as favorable to Pilgrim as possible, this report also adopts a number of other Edison assumptions which are biased in favor of Pilgrim. The Pilgrim plant is assumed to be operable until the year 2012 -- a total of 40 years from when it entered service. The oldest commercial nuclear plant has operated for only 26 years, and 14 reactors have been retired after less than 20 years of operation. Pilgrim's operating license currently expires in the year 2008, and would have to be extended by the NRC in order for the plant to operate until 2012.

Real nuclear fuel costs are assumed to remain stable, even though approximately half of the uranium used in domestic nuclear plants is imported, much of it from politically unstable countries such as South Africa.[12]

BECO's estimates for nuclear waste disposal and for dismantling the radioactive plant are used, despite the fact that the necessary technologies have not yet been demonstrated and there is therefore enormous uncertainty around estimating these costs. And it is assumed that no serious nuclear accidents occur at Pilgrim or at any other U.S. nuclear plant. The conservative nature of these assumptions is discussed in more detail in Appendix C.

3. Economic Benefits of Retiring Pilgrim

There are three categories of potential costs to ratepayers for retiring Pilgrim at this time. First, there is the cost of replacement power. Second, there are costs to shut the plant down and decommission it, which must be paid whether the plant is retired now or later. Third, there is the potential cost of paying for past investment in the plant. Each cost will be considered separately.

A. Replacement power

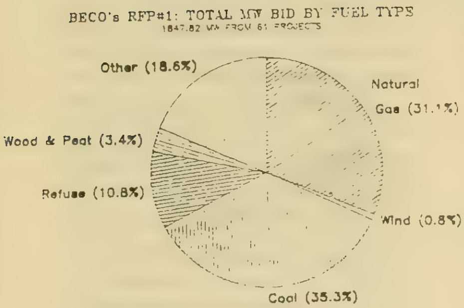
The main cost of retiring Pilgrim would be to replace the electricity produced by the nuclear plant. As demonstrated in the recent New England Energy Policy Council study, *Power to Spare*, the least expensive means of obtaining new power supplies is to "mine" the electricity that is now wasted by inefficient lighting, appliances, and other electrical equipment in our offices, factories and homes. **Utilities around the United States have found that they can finance efficiency improvements for their customers at an average cost of less than two cents per Kwh.[13] That is less expensive than operation and maintenance costs alone at Pilgrim.** A report to Boston Edison's Board of Directors in March, 1987, found that cost-effective efficiency improvements could reduce electric demand in Boston Edison's service territory by as much as 1,000 Mw over the next 15 years.[14]

Another readily available source of replacement power for Pilgrim would be the purchase of electricity from new plants built and owned by independent small power producers, generally referred to as "Qualifying Facilities" or "QFs." Since the passage of the federal Public Utility Regulatory Policies Act (PURPA) of 1978, which required utilities to purchase power from independent producers at fair prices, there has been a rapid increase in the development of such facilities throughout the country.

In January, 1987, in response to rules enacted by the Massachusetts Department of Public Utilities, Boston Edison sent a Request for Proposals to potential developers to supply 200 megawatts (Mw) of Edison's power needs by 1992. The utility's projection of future oil costs was set as the ceiling price for acceptable offers. In June Edison received bids from 61 projects, representing a total of 1848 Mw. The number of proposals received was well above the utility's expectations. In fact, in its April 1987 forecast, the New England Power Pool had projected that only 1391 Mw of independent power would be available for the entire region by the year 2002.[15]

The majority of the proposals were for cogeneration facilities -- which produce useful heat and electricity in the same process -- and other small power facilities using a variety of fuels

Figure 7



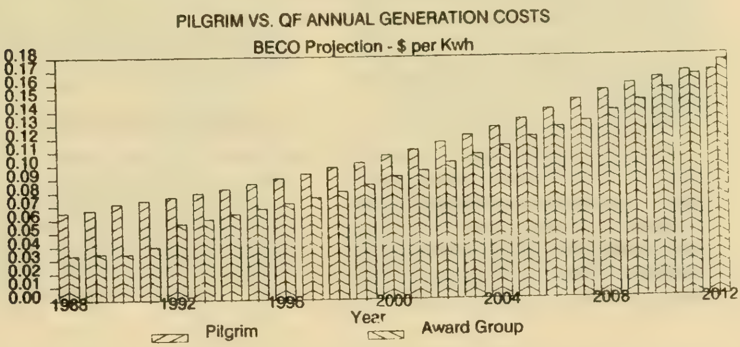
(Figure 7). Over 240 Mw would be produced using renewable energy sources, such as biomass, wind or hydropower.

Some of the projects, particularly the 200 Mw of plants which would burn refuse as fuel, may present environmental problems. MASSPIRG does not necessarily endorse all of the proposed QFs. However, the combination of energy efficiency improvements and the large number of small power and cogeneration projects provides a more than adequate pool of potential replacement power for Pilgrim. **The combined potential of energy efficiency improvements and independent power projects exceeds Edison's share of the Pilgrim plant and its forecast of power needed to meet increased demand through the year 2012 by over 1,100 Mw.**[16]

Nine QF projects, representing 350 Mw, were selected by Edison as an initial "Award Group" for final contract negotiation. **The average Award Group bid was significantly below the price of Pilgrim-generated electricity, even using all of Boston Edison's Pilgrim cost assumptions (Figure 8).**

If Pilgrim were to be replaced, there would be a second round of bidding. It is quite likely that many bids would be lowered given the large, and previously unknown, surplus of potential supply over Edison's demand. In the first round, potential developers were bidding primarily against BECO's extremely high projection of oil price increases. The utility forecasts oil prices to increase at an average rate of over ten percent a year, approximately five percent above the assumed inflation rate between now and the year 2012. Oil prices would increase from their current $20 per barrel to $166 per barrel in 2012, or to over $53 a barrel in 1987 dollars adjusted for inflation.

Figure 8



To be as favorable to Pilgrim as possible, however, the Award Group bids are assumed by MASSPIRG to represent the low end of a range of replacement power costs. Efficiency savings are assumed to be used entirely to displace demand growth rather than to replace Pilgrim. The average bid of the next block of 740 Mw is used as a middle estimate of Pilgrim replacement costs. And the average bid of all the non-Award Group projects is adopted as a high estimate of replacement power costs.

Using BECO's assumption of a 70 percent capacity factor for Pilgrim, the total present value of replacement power needed would range from \$2.5 billion, based on the Award Group, to \$2.9 billion, based on the average non-Award Group bid, through the year 2012 (Figure 9). If one assumes lower Pilgrim capacity factors, replacement power would cost even less.

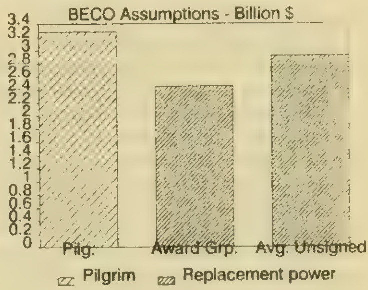
All the proposed QFs have projected in-service dates before 1992, with 400 Mw expected to be available by the end of 1990. For this study, it is assumed that all QFs begin operation in 1992. Until that time, replacement power costs are assumed to equal energy costs from reserve oil-fired plants, plus an additional charge by the New England Power Pool for providing reserve capacity. The 1987 New England Power Pool forecast shows a more than adequate reserve margin of generating capacity through 1992 -- even if the Pilgrim, Seabrook, and Maine Yankee plants are not in service.[17]

Reliance on non-utility power plants poses certain obvious risks to a utility, since it will not control the construction or operation of the QF plants. These risks must be weighed against risks associated with Pilgrim, however. Pilgrim could be closed by federal regulators because of an accident at another nuclear plant, as well as by incidents at the plant itself. The diversity of the QF projects makes it more likely that a given amount of power will be available at all times

The QF contracts also provide insulation from important financial risks, since they are based on payment per Kwh produced. Their private owners thus assume the risks of cost overruns, poor plant performance and profitability. Most of the Award Group contracts are tied to the Consumer Price Index, thereby requiring utility customers to bear only the risk of unan-

Figure 9

PILGRIM VS. REPLACEMENT POWER COSTS



ticipated general inflation. With Pilgrim, however, ratepayers are expected to bear the risk of *all* cost increases, including inflation, as well as the risk that the plant does not perform as reliably as expected.

B. Other shutdown costs

A decision to retire Pilgrim at this time would involve some costs in addition to replacement power. Decommissioning costs, for instance, would still have to be incurred whenever Pilgrim

is retired. Actually, since the cost of decommissioning is likely to increase as the plant becomes more radioactive, it would almost certainly be cheaper to decommission it earlier. To be conservative, however, these potential savings are not considered here. Costs that would clearly have to be incurred to shut Pilgrim down must be added to the cost of replacement power (or subtracted from the cost of Pilgrim) to evaluate the economics of early retirement of the plant.

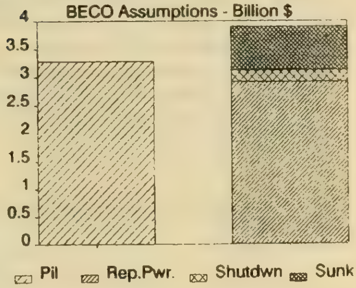
In addition to direct decommissioning costs of $126 million in 1987 dollars, BECO estimates that closing Pilgrim will require additional operation and maintenance costs over a five year decommissioning period. The total decommissioning and shutdown costs add $206 million, in addition to the cost of replacement power, to the present value cost of retiring Pilgrim. Edison fails to include these costs in its analysis of continuing to operate Pilgrim, however, presumably because the costs would be incurred after the year 2012 -- the last year BECO looks at. In the MASSPIRG scenarios, the present value of the post-operation costs are included in both early and late retirement scenarios.

C. Sunk costs.

Another potential cost to retiring Pilgrim is repayment of the money that Edison has invested in the plant to date -- generally referred to as "sunk costs." Pilgrim sunk costs will total $846 million by the end of 1987. **In its analyses of the cost of retiring Pilgrim, BECO effectively assumes that ratepayers would pay for the utility's entire investment in Pilgrim, along with the same rate of profit it would earn if the plant were operated (Figure 10).**

Figure 10

PILGRIM OPERATION VS. RETIREMENT



In addition to its investment in the plant itself, Edison also includes a $50 million investment in an inventory of nuclear fuel and $20 million in materials and supplies in Pilgrim sunk costs. After the Pilgrim 2 unit was canceled, however, BECO was able to recover 64 percent of its investment in nuclear fuel by selling it to other utilities.[18] In the MASSPIRG scenarios, therefore, it is also assumed that BECO will recover 64 percent of its current investment in fuel, materials and supplies through sales to other utilities.

If Pilgrim were retired, it would actually be up to the Department of Public Utilities (DPU) to determine who should pay for Pilgrim sunk costs. Under a policy adopted in a Western Massachusetts Electric Company case in 1984, the DPU ruled that sunk cost recovery would no longer be allowed for investments that were not "used and useful" to utility customers, such as plants that were canceled while still under construction.[19] In a 1985 decision on excess capacity, the Department modified its policy to allow utilities to recover uneconomic investments over time, but without charging

ratepayers for financing charges.[20] This policy, which is followed by most state utility commissions, results in a sharing of sunk costs between utility ratepayers and investors. Stockholders are also able to share their losses with the federal government, which allows generous tax deductions for investment losses.[21]

D. Alternative scenarios show savings from retiring Pilgrim.

Three scenarios were constructed to cover the widest reasonable range of assumptions for the costs of operating or retiring Pilgrim. The Pilgrim Optimistic Case combines all the assumptions

Table 1. ALTERNATIVE ASSUMPTIONS USED IN MASSPIRG PILGRIM PROJECTIONS

	Capacity Factor	Capital Additions	O&M Expenses	Replacement Power
Pilgrim Historical Trend Case	Pilgrim Historical 50%	Pilgrim Historical 10 years	Pilgrim Historical	Averge of Award Group QFs
National Trend Case	National Trend Pilgrim to 4/86 56%	National Trend 5 years	National Trend	Average of Next 740 MW QFs
Pilgrim Optimistic Case	National avg. all BWRs 63.2%	Pilgrim Low Historical 5 years	2% Real Escalation	Average of all 1327 MW Unsigned QFs
Boston Edison	70%	0.5% Real Escalation	0.5% Real Escalation	Average of all 1327 MW Unsigned QFs

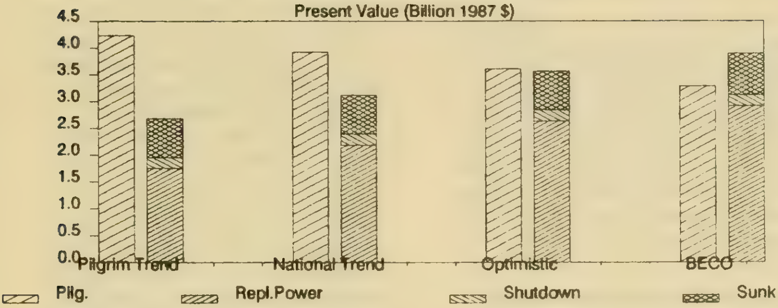
Table 2. ADDITIONAL CONSERVATISMS IN ALL SCENARIOS

Nuclear waste disposal:	No increases from current BECO assumptions
Shutdown:	No savings from early decommissioning
Capacity factor:	No declining effect from salt-water cooling
Capital Additions:	No increases after 5-10 years BECO-assumed decreases in last five years of operation No repeat of 1984 and 1987 major repairs
O&M and Capital Additions:	Linear rather than exponential trend increases
Miscellaneous:	40-year lifetime No increases in nuclear insurance No serious accidents No societal costs No nuclear subsidies included in Pilgrim costs

Figure 11

PILGRIM OPERATION VS. RETIREMENT

Present Value (Billion 1987 $)



most favorable to Pilgrim -- the most optimistic projections of Pilgrim costs, and the highest price for replacement power, equal to the average bids of all non-Award Group QFs. The National Trend Case assumes that Pilgrim costs improve to the level predicted by the national trend for a plant with Pilgrim's characteristics. A middle estimate of replacement power is used, equal to the price of the least expensive 740 Mw of QF bids after the Award Group. The Pilgrim Historical Case assumes that all Pilgrim cost components follow the same trends they have in the past, and that replacement power could be obtained for the price of the Award Group bids from QFs. Table 1 summarizes the assumptions employed in each scenario. Table 2 lists the additional assumptions favorable to Pilgrim that were made in all MASSPIRG scenarios.

The alternative scenarios indicate that **the present value of savings to ratepayers from <u>retiring</u> the plant would range from $46 million to $1.6 billion over 25 years, even if ratepayers were to pay for all sunk costs (Table 3; Figure 11). The $1.6 billion savings is approximately equal to $540 for the average Edison residential customer.** If investors were to pay sunk costs, the savings from retiring Pilgrim would increase to a range of $769 million to

SAVINGS TO RATEPAYERS FROM RETIRING PILGRIM

	Ratepayers Pay Sunk Costs	Investors Pay Sunk Costs
Pilgrim Historical Trend Case	$1.56 billion	$2.28 billion
National Trend Case	$813 million	$1.54 billion
Pilgrim Optimistic Case	$49 million	$773 million
BECO Assumptions	-$611 million	$168 million

$2.3 billion. Detailed annual costs for all scenarios are presented in Appendix A.

Figure 12 illustrates how the present value of the cumulative savings from retiring Pilgrim changes over time in each scenario, assuming that ratepayers pay for the full sunk costs, including a profit on Pilgrim investment to date. The cumulative savings at any point in time is equal to the difference between total Pilgrim costs and the total costs of replacement power, shutdown and sunk costs to that time.

Graphs of cumulative savings are especially useful for looking at the effect of changing only one assumption at a time on the benefits of retiring Pilgrim. Figure 13 illustrates the effect of changing only the assumption about how regulators might deal with Pilgrim sunk costs if the plant were retired. The middle line represents the usual regulatory practice for plants canceled under construction, where ratepayers would repay all sunk costs over time but with the utility earning no profit on its sunk investment. In this case, it is assumed that Pilgrim sunk costs would be charged to ratepayers over the same 25 year period as they would have been if the plant had operated. **Under traditional regulatory practice, ratepayers would save money, at least through the year 2008, by retiring Pilgrim, even if all BECO assumptions about the plant's future costs hold.**

Figure 12

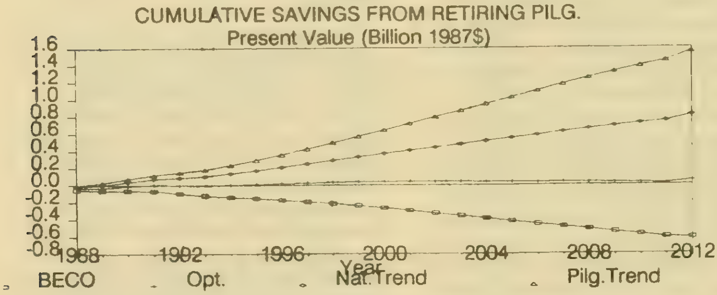
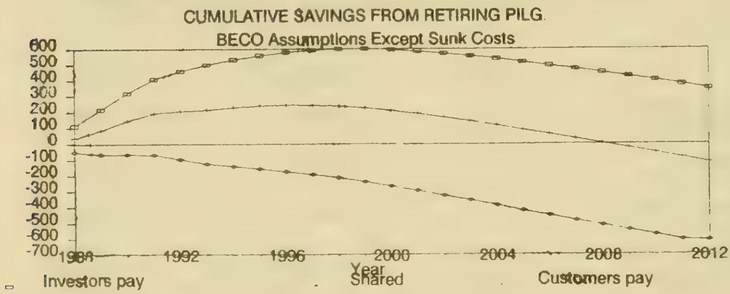


Figure 13



4. Conclusions and Recommendations

Retiring Pilgrim would clearly save utility customers money, under a wide range of reasonable assumptions, even if ratepayers have to pay a full return on the sunk costs of the plant. **The Pilgrim nuclear plant should therefore be immediately and permanently retired.**

While no state official or agency has the direct authority to order the shutdown or retirement of a nuclear plant, the Massachusetts Department of Public Utilities (DPU) is responsible for determining what, if any, utility investments and expenses can be charged to ratepayers, under a broad statutory mandate to ensure just and reasonable electric rates. If it were to determine that ongoing investment in Pilgrim were uneconomical, the DPU could prohibit its owners from financing or charging ratepayers for future investment in the plant.

MASSPIRG therefore recommends that the DPU disallow recovery of any additional Pilgrim investment, including the $150 million in capital additions Boston Edison has budgeted to spend in 1987. A second round of bidding from potential power suppliers should be initiated, with reasonable assumptions about Pilgrim costs used to set a target for acceptable bids. Energy efficiency contractors, who could sell energy savings to the utility, should also be encouraged to compete with QFs in bidding to replace Pilgrim.

A similar process for dealing with new power plant construction has recently been proposed to the DPU by the state Executive Office of Energy Resources.[22] Decisions to continue investing in plants that have already been in operation are no different from decisions to start new construction, or to complete partially built plants. In each case, the ongoing investment must be weighed against potential alternatives. New utility investment in power plants should be allowed only if it would be "used and useful" -- necessary to provide reliable electric service and the most economical alternative. To the extent that the Pilgrim plant cannot meet that test -- and this report finds that it cannot -- the plant should be permanently retired.

APPENDIX A

ANNUAL COSTS OF PILGRIM VS. ALTERNATIVES

BECO ASSUMPTIONS

(in millions of dollars)

Year	Capital Additions	Total Plant Year End	Ann. Depreciation	Accumulated Depreciation	Net Plant Year-End	Deferred Tax	Materials	Fuel	Avg. Rate Base	Return on Rate Base	Income Tax	Depreciation	Insurance	Local Tax	Decommissioning	Fuel	O&M	PILGRIM TOTAL: Annual Costs	PILGRIM TOTAL: Cost in Cents per kwh	PILGRIM TOTAL: Incremental (mil.)	PILGRIM TOTAL: Cost in Cents per kwh	QFs: Cost in Cents per kwh	QFs: Annual Cost (mil.)
1987	150	846	24	176	670	-104	20	51	562	58	27	24	5	11	4	1	97	227	5.5	1	0.0	3.3	[illegible]
1988	40	886	28	204	682	-113	21	51	621	64	30	28	5	11	5	27	99	268	6.5	92	2.2	3.5	143
1989	40	926	29	233	693	-122	22	50	623	64	30	29	5	11	5	24	107	276	6.7	126	3.1	3.6	14[illegible]
1990	70	996	32	265	731	-130	23	50	640	66	31	32	5	12	5	24	120	294	7.2	152	3.7	3.7	152
1991	40	1036	34	299	737	-138	24	50	654	68	32	34	6	12	5	24	125	305	7.4	169	4.1	4.2	174
1992	42	1078	36	335	743	-143	26	50	655	68	32	36	6	12	6	24	131	314	7.6	185	4.5	5.7	23[illegible]
1993	44	1122	38	373	749	-147	27	54	661	68	32	38	6	12	6	26	138	326	7.9	202	4.9	6.1	251
1994	46	1168	41	414	754	-146	28	56	670	69	33	41	6	12	7	27	145	339	8.3	240	5.8	6.6	272
1995	49	1217	43	457	760	-143	30	60	683	71	33	43	7	12	7	29	152	353	8.6	258	6.3	7.2	29[illegible]
1996	51	1268	46	503	765	-139	31	66	697	72	34	46	7	13	7	31	160	370	9.0	278	6.8	7.8	32[illegible]
1997	54	1322	49	553	769	-136	33	67	706	73	35	49	7	12	8	32	168	384	9.3	294	7.2	8.5	349
1998	56	1378	53	606	772	-133	34	75	721	74	35	53	8	12	8	36	176	403	9.8	316	7.7	9.2	378
1999	59	1437	57	663	774	-129	36	75	726	75	36	57	8	12	9	36	185	418	10.2	334	8.1	10.2	42[illegible]
2000	62	1499	62	725	774	-126	38	84	739	76	36	62	9	13	9	40	194	439	10.7	358	8.7	11.1	457
2001	65	1564	67	792	772	-121	40	84	742	77	36	67	9	13	10	40	204	455	11.1	377	9.2	12.0	491
2002	68	1633	73	866	767	-115	42	92	752	78	37	73	9	12	11	44	214	478	11.6	402	9.8	13.2	54[illegible]
2003	72	1705	80	946	759	-105	44	94	755	78	37	80	10	12	11	45	225	498	12.1	425	10.3	13.9	5[illegible]3
2004	75	1780	88	1035	746	-93	46	99	760	79	37	88	10	12	12	47	236	522	12.7	451	11.0	15.1	621
2005	79	1859	98	1133	727	-78	48	105	762	79	37	98	11	11	13	50	248	547	13.3	478	11.6	16.5	67[illegible]
2006	83	1942	110	1242	700	-60	51	111	761	79	37	110	11	11	14	53	260	575	14.0	508	12.4	17.8	72[illegible]
2007	87	2030	124	1366	663	-37	53	118	754	78	37	124	12	11	15	56	273	605	14.7	540	13.2	18.6	765
2008	70	2100	140	1506	594	-9	43	125	718	74	35	140	13	9	16	59	287	633	15.4	570	13.9	19.9	819
2009	56	2156	155	1661	494	26	34	94	619	64	30	155	13	8	17	63	301	652	15.9	591	14.4	21.2	870
2010	45	2200	172	1834	367	66	27	62	500	52	24	172	14	6	19	67	316	669	16.3	610	14.8	22.5	922
2011	36	2236	192	2026	210	115	22	31	361	37	18	192	15	3	21	71	332	688	16.7	629	15.3	23.8	979
2012	29	2265	239	2265	0	0	17	0	3	0	0	239	15	0	11	75	348	688	16.8	645	15.7	25.3	1038
2013																	139						
2014																	70						
2015																	70						
2016																	70						
2017																	70						
2018																	70						
Total Present Value																		3287		2302			2[illegible]13

ANNUAL COSTS OF PILGRIM VS. ALTERNATIVES

OPTIMISTIC CASE

(in millions of dollars)

Year	Capital Additions	Total Plant Year End	Ann. Depreciation	Accumulated Depreciation	Net Plant Year End	Deferred Tax	Materials	Fuel	Avg. Rate Base	Return on Rate Base	Income Tax	Depreciation	Insurance	Local Tax	Decommissioning	Fuel	O&M	PILGRIM TOTAL: Annual Costs	PILGRIM TOTAL: Cost in Cents per kwh	PILGRIM TOTAL: Incremental (mil.)	PILGRIM TOTAL: Cost in Cents per kwh	QFs: Cost in Cents per kwh	QFs: Annual Cost (mil)
1987	150	846	24	176	670	-104	20	51	562	58	27	24	5	11	4	1	97	226	6.1	8	0.2	3.3	[illegible]
1988	45	891	28	204	687	-113	21	51	624	64	30	28	5	11	5	24	99	266	7.2	98	2.7	3.5	[illegible]
1989	50	941	30	234	707	-122	22	50	633	65	31	30	5	11	5	21	107	275	7.4	134	3.6	3.6	[illegible]
1990	70	1011	32	266	745	-130	23	50	653	67	32	32	5	12	5	21	120	295	7.9	160	4.3	3.7	[illegible]
1991	60	1071	35	301	770	-139	24	50	675	70	33	35	6	12	5	21	125	308	8.3	179	4.8	4.2	157
1992	66	1137	38	339	798	-145	26	50	695	72	34	38	6	13	6	21	131	321	8.6	199	5.4	5.7	[illegible]
1993	69	1206	42	381	825	-150	27	54	722	75	35	42	6	13	6	23	138	338	9.1	220	5.9	6.1	[illegible]
1994	73	1279	45	426	853	-150	28	56	751	78	37	45	6	14	7	24	145	355	9.6	263	7.1	6.6	[illegible]
1995	76	1356	49	476	880	-148	30	60	783	81	38	49	7	14	7	26	152	374	10.1	285	7.7	7.2	[illegible]
1996	80	1436	54	530	906	-147	31	66	816	84	40	54	7	15	7	28	161	396	10.7	310	8.4	7.8	289
1997	84	1520	59	589	931	-145	33	67	843	87	41	59	7	15	8	29	172	418	11.3	334	9.0	8.5	[illegible]
1998	89	1609	65	654	954	-144	34	75	876	91	43	65	8	15	8	32	183	445	12.0	364	9.8	9.2	342
1999	93	1702	71	726	976	-142	36	75	899	93	44	71	8	15	9	32	195	468	12.6	390	10.5	10.2	[illegible]
2000	98	1799	79	805	995	-139	38	84	929	96	45	79	9	16	9	36	208	498	13.4	422	11.4	11.1	412
2001	102	1902	87	892	1010	-136	40	84	947	98	46	87	9	16	10	36	222	524	14.1	451	12.2	12.0	443
2002	108	2009	97	988	1021	-130	42	92	971	100	47	97	9	16	11	40	236	556	15.0	485	13.1	13.2	488
2003	113	2122	108	1096	1026	-120	44	94	987	102	48	108	10	16	11	40	251	586	15.8	517	14.0	13.9	517
2004	119	2241	121	1217	1024	-108	46	99	1002	104	49	121	10	16	12	43	267	622	16.8	555	15.0	15.1	[illegible]
2005	125	2366	136	1353	1013	-91	48	105	1013	105	50	136	11	15	13	45	284	659	17.8	593	16.0	16.5	611
2006	131	2496	154	1507	990	-68	51	111	1018	105	50	154	11	15	14	48	303	700	18.9	637	17.2	17.8	[illegible]
2007	137	2634	176	1683	951	-39	53	118	1014	105	50	176	12	14	15	51	322	745	20.1	683	18.4	[illegible]	[illegible]
2008	110	2744	201	1884	859	-2	43	125	970	100	47	201	13	13	16	54	343	786	21.2	726	19.6	19.9	[illegible]
2009	88	2831	226	2110	721	44	34	94	849	88	42	226	13	11	17	57	365	818	22.1	760	20.5	21.2	786
2010	70	2902	252	2362	540	101	27	62	695	72	34	252	14	8	19	60	389	848	22.9	790	21.3	22.5	833
2011	56	2958	284	2646	312	171	22	31	508	53	25	284	15	5	21	64	414	879	23.7	822	22.2	23.8	[illegible]
2012	45	3003	357	3003	0	263	17	0	257	27	13	357	15	0	11	68	440	930	25.1	886	23.9	[illegible]	[illegible]
2013																	176						
2014																	88						
2015																	88						
2016																	88						
2017																	88						
2018																	88						
Total Present Value																		3608		2679			[illegible]

ANNUAL COSTS OF PILGRIM VS. ALTERNATIVES

NATIONAL TREND CASE

(in millions of dollars)

Year	Capital Additions	Total Plant Year End	Ann. Depreciation	Accumulated Depreciation	Net Plant Year-End	Deferred Tax	Materials	Fuel	Avg. Rate Base	Return on Rate Base	Income Tax	Depreciation	Insurance	Local Tax	Decommissioning	Fuel	O&M	<-- PILGRIM TOTAL --> Annual Costs	Cost in Cents per kwh	Incremental (mil.)	Cost in Cents per kwh	-- QFs -- Cost in Cents per kwh	Annual Cost (mil.)
1987	150	846	24	176	670	-104	20	51	562	58	27	24	5	11	4	1	97	226	6.9	8	0.2	3.3	27
1988	62	908	28	204	704	-113	21	51	632	65	31	28	5	11	5	22	99	265	8.1	97	3.0	3.4	113
1989	68	976	31	235	741	-123	22	50	657	68	32	31	5	12	5	19	107	278	8.5	137	4.2	3.6	117
1990	75	1051	34	269	782	-132	23	50	686	71	34	34	5	12	5	19	120	299	9.1	165	5.0	3.6	119
1991	82	1133	37	306	827	-141	24	50	719	74	35	37	6	13	5	19	125	315	9.6	187	5.7	4.2	136
1992	90	1223	42	348	875	-148	26	50	758	78	37	42	6	14	6	19	131	332	10.1	210	6.4	5.7	186
1993	94	1318	46	394	923	-155	27	54	803	83	39	46	6	14	6	21	138	353	10.8	236	7.2	6.1	200
1994	99	1417	51	445	971	-156	28	56	850	88	42	51	6	15	7	21	145	375	11.4	283	8.6	6.5	215
1995	104	1521	57	502	1019	-157	30	60	900	93	44	57	7	16	7	23	152	398	12.1	309	9.4	7.0	230
1996	109	1630	63	565	1065	-157	31	66	951	98	46	63	7	17	7	25	161	425	12.9	339	10.3	7.5	248
1997	115	1745	70	635	1109	-157	33	67	995	103	49	70	7	17	8	26	174	454	13.8	370	11.3	8.2	268
1998	121	1865	78	713	1152	-157	34	75	1044	108	51	78	8	18	8	29	188	488	14.8	407	12.4	8.7	288
1999	127	1992	87	800	1192	-157	36	75	1083	112	53	87	8	18	9	29	204	519	15.8	441	13.4	9.6	314
2000	133	2125	97	897	1228	-156	38	84	1127	117	55	97	9	19	9	32	219	557	16.9	481	14.6	10.3	340
2001	139	2264	108	1005	1259	-154	40	84	1159	120	57	108	9	20	10	32	236	591	18.0	518	15.8	11.0	362
2002	146	2411	121	1126	1284	-149	42	92	1196	124	58	121	9	19	11	35	254	631	19.2	560	17.0	12.0	394
2003	154	2564	136	1262	1302	-139	44	94	1224	126	60	136	10	20	11	36	272	671	20.4	602	18.3	12.7	417
2004	161	2726	154	1416	1310	-125	46	99	1249	129	61	154	10	20	12	38	292	716	21.8	649	19.8	13.6	448
2005	170	2896	174	1590	1305	-106	48	105	1267	131	62	174	11	19	13	40	313	763	23.2	698	21.2	14.7	484
2006	178	3074	199	1790	1284	-80	51	111	1277	132	62	199	11	19	14	42	336	816	24.8	753	22.9	15.8	519
2007	187	3261	230	2019	1241	-44	53	118	1275	132	62	230	12	18	15	45	359	873	26.5	811	24.7	16.5	541
2008	150	3410	263	2282	1128	2	43	125	1223	126	60	263	13	16	16	47	385	926	28.2	866	26.3	17.6	578
2009	120	3530	297	2579	950	61	34	94	1080	112	53	297	13	14	17	50	411	967	29.4	909	27.6	18.6	612
2010	96	3625	333	2912	713	135	27	62	890	92	44	333	14	11	19	53	440	1004	30.6	947	28.8	19.7	648
2011	77	3702	376	3288	414	227	22	31	655	68	32	376	15	6	21	56	470	1043	31.7	986	30.0	20.9	688
2012	61	3763	475	3763	0	346	17	0	333	34	16	475	15	0	11	60	501	1113	33.9	1069	32.5	22.2	731
2013																	201						
2014																	100						
2015																	100						
2016																	100						
2017																	100						
2018																	100						
Total Present Value																		3928		2998			2185

ANNUAL COSTS OF PILGRIM VS. ALTERNATIVES

PILGRIM TREND CASE

	Capital Additions	Total Plant Year End	Ann. Depreciation	Accumulated Depreciation	Net Plant Year-End	Deferred Tax	Materials	Fuel	Avg. Rate Base	Return on Rate Base	Income Tax	Depreciation	Insurance	Local Tax	Decommissioning	Fuel	O&M	<-- PILGRIM TOTAL --> Annual Costs	Cost in Cents per kwh	Incremental (mil.)	Cost in Cents per kwh	<-- Alts - Cost in Cents per kwh	[illegible]
	(in millions of dollars)																						
87	150	846	24	176	670	-104	20	51	562	58	27	24	5	11	4	1	97	226	7.7	8	0.3	3.3	[illegible]
88	66	912	28	205	708	-113	21	51	634	65	31	28	5	11	5	19	99	263	9.0	95	3.3	3.3	[illegible]
89	73	985	31	236	750	-123	22	50	663	69	32	31	5	12	5	17	107	277	9.4	136	4.6	3.5	[illegible]
90	80	1066	34	270	796	-132	23	50	697	72	34	34	5	13	5	17	120	300	10.2	165	5.6	3.4	[illegible]
91	88	1154	38	308	846	-142	24	50	734	76	36	38	6	13	5	17	125	316	10.8	188	6.4	4.[illegible]	[illegible]
92	97	1251	43	351	900	-149	26	50	778	80	38	43	6	14	6	17	131	335	11.4	213	7.2	5.7	16
93	106	1356	48	398	958	-156	27	54	830	86	41	48	6	15	6	18	139	357	12.2	240	8.2	6.0	17
94	116	1472	53	452	1020	-159	28	56	888	92	43	53	6	16	7	19	146	382	13.0	290	9.9	6.4	18
95	126	1598	60	512	1086	-160	30	60	953	99	47	60	7	17	7	20	159	415	14.2	326	11.1	6.8	199
[illegible]	138	1736	68	580	1156	-161	31	66	1024	106	50	68	7	18	7	22	173	452	15.4	366	12.5	7.2	[illegible]
97	150	1886	77	657	1229	-162	33	67	1092	113	53	77	7	19	8	23	189	489	16.7	405	13.8	7.6	[illegible]
98	157	2043	87	744	1299	-164	34	75	1167	121	57	87	8	20	8	26	205	532	18.1	451	15.4	8.0	[illegible]
99	165	2209	99	843	1366	-165	36	75	1230	127	60	99	8	21	9	26	223	572	19.5	494	16.8	8.5	[illegible]
[illegible]	174	2382	112	954	1428	-165	38	84	1298	134	63	112	9	22	9	29	241	619	21.1	543	18.5	9.1	[illegible]
01	182	2565	127	1081	1484	-164	40	84	1352	140	66	127	9	23	10	29	260	663	22.6	590	20.1	9.5	[illegible]
02	191	2756	144	1225	1532	-160	42	92	1410	146	69	144	9	23	11	31	280	713	24.3	642	21.9	10.1	[illegible]
[illegible]	201	2957	163	1388	1569	-150	44	94	1457	151	71	163	10	23	11	32	302	763	26.0	695	23.7	10.7	14
04	211	3168	186	1574	1594	-135	46	99	1499	155	73	186	10	24	12	34	325	819	27.9	753	25.6	11.3	33
005	222	3390	213	1787	1603	-113	48	105	1532	158	75	213	11	23	13	36	349	878	29.9	813	27.7	12.0	35[illegible]
[illegible]	233	3623	246	2033	1590	-83	51	111	1553	161	76	246	11	23	14	38	375	944	32.2	881	30.0	12.7	[illegible]
[illegible]	244	3867	285	2318	1549	-41	53	118	1557	161	76	285	12	22	15	40	403	1014	34.6	952	32.5	13.1	[illegible]
[illegible]	195	4062	329	2647	1415	15	43	125	1500	155	73	329	13	19	16	42	432	1080	36.8	1020	34.8	13.9	[illegible]
09	156	4219	373	3021	1198	88	34	94	1335	138	65	373	13	17	17	45	463	1133	38.6	1074	36.6	14.6	[illegible]
[illegible]	125	4344	420	3441	903	178	27	62	1108	115	54	420	14	13	19	48	496	1179	40.2	1121	38.2	15.5	[illegible]
011	100	4444	476	3917	527	292	22	31	822	85	40	476	15	7	21	50	531	1226	41.8	1169	39.8	16.5	4
12	80	4524	607	4524	0	444	17	0	421	44	21	607	15	0	11	54	568	1318	44.9	1274	43.4	17.5	[illegible]
13																	227						
14																	114						
15																	114						
[illegible]																	114						
17																	114						
18																	114						
[illegible]sent [illegible]																		4236		3306			175

Notes to Appendix A

Assumptions and Methods

Capital Additions:

BECO: Escalation of approximately .5 percent per year, after adjusting for inflation, from about $30 million per year (1986 constant dollars). Declines by 23 percent a year over last five years of plant's life.

Optimistic: Linear growth at $2.5 million per year for five years to approximately $50 million per year (1986 dollars), followed by same escalation and decline as BECO. Derived from linear regression of Pilgrim historical experience between 1973 and 1976, treating the four years with expenditures significantly above the trend line as one-time expenditures which will not recur.

National Trend: Linear growth at $3.2 million per year for five years to $69 million per year (1986 $), followed by same pattern as BECO. Derived from ESRG multi-variate regression equation applied to Pilgrim.

Pilgrim Trend:

Linear growth at $3.5 million per year for 10 years to $92 million per year year (1986$), followed by same pattern as BECO. Derived from linear regression, excluding two largest outliers.

Plant-in-Service Year End:

Calculated as in BECO Exhibit 1.

= Capital Additions + Prior Total Plant Year End

Annual Depreciation:

= (Half of Year's Capital Additions + Prior Year Net Plant) / Remaining Life

Deferred Taxes:

Calculated as in BECO Exhibit 2.

Prior Year Accumulated Deferred Taxes + (Tax Rate x (Year's Tax Depreciation - Year's Book Depreciation))

Year's Tax Depreciation calculated as in BECO Exhibit 2 (150% Double Declining Balance).

Materials & Supplies:

From BECO Exhibit 1.

Nuclear Fuel in Rate Base:

From BECO Exhibit 1.

Average Rate Base:

Calculated as in BECO Exhibit 1.

= Net plant Year End + Deferred Taxes + Materials & Supplies + Nuclear Fuel in Rate Base - Half of Year's Capital Additions

Return on Rate Base:

Calculated as in BECO Exhibit 1.

= Average Rate Base x 10.338%

Income Taxes:
Calculated as in BECO Exhibit 1.

= Average Rate Base x 4.89%

Insurance
From BECO Exhibit 1.

Local Taxes
Calculated as in BECO Exhibit 1.

= Average Rate Base x 1.8%

Decommissioning contribution:
From BECO Exhibit 1.

Sinking fund to accumulate $126 million (1986$) by 2012.

Fuel:
Calculated from BECO Exhibit 1.

BECO's annual fuel estimate adjusted by ratio of assumed capacity factor to BECO's assumed capacity factor of 70%.

O&M Costs:
<u>BECO</u>: 0.5% per year from 1990

<u>Optimistic</u>: 2% real growth from year when BECO projection crosses National Trend line.

<u>National Trend</u>: Same as BECO to 1990. Linear growth of $3.6 million per year thereafter (1986$); derived from ESRG equation applied to Pilgrim characteristics.

<u>Pessimistic:</u>

Same as BECO to 1990. Then linear growth of $4.4 million per year (1986$) per year derived from linear regression of Pilgrim historical O&M costs from 1973 to 1986.

Present value of O&M shutdown costs is included in present value of year 2012 O&M. Year 2013 O&M is assumed to be 40% of prior year; 20% for the five years thereafter. Based on BECO Exhibit 2.

Annual Costs:
= Return + Income Tax + Depreciation + Insurance + Local Tax + Decommissioning + Fuel + O&M

Costs in Cents per Kwh:
= Annual Cost / Annual Generation

Annual Generation = Capacity [670000 Kw] x 8760 hours/yr. x Capacity Factor

Capacity Factor:
<u>BECO</u>: 70%

<u>Optimistic</u>:

Average of seven BWRs between 400 - 799 Mw for 1977-1986

= 63.159%

From North American Electric Reliability Council, Equipment Availability Report 1975 - 1986.

National Trend:

56 percent; derived from ESRG regression equation for Pilgrim and equal to Pilgrim's lifetime capacity factor before its shutdown in April, 1986.

Pilgrim Trend:

50 percent; Pilgrim's lifetime capacity factor as of October 1987.

Incremental Costs:

Incremental cost comparison is BECO's preferred way of comparing future Pilgrim costs with alternatives. Comparing Pilgrim incremental costs (which subtract shutdown and sunk cost charges from Pilgrim total costs) to alternative costs is the same as comparing Pilgrim total costs to alternative costs plus shutdown and sunk cost charges.

As in BECO Exhibit 2

= Annual Cost - Cost of service on sunk costs

Cost of service on sunk costs includes return and depreciation (amortization) on sunk costs as of end of 1987 (846 million); plus O&M costs of $40 million in 1988 and $20 million per year in 1989-1993; plus insurance of $2.3 million per year 1988-1993; plus property taxes declining from $9 million in 1988 to $1 million in 1993 and thereafter; plus decommissioning. In BECO Case $50 million in nuclear fuel and $20 million in materials and supplies is included in sunk cost rate base. In MASSPIRG scenarios, it is assumed that 64% of the investment in fuel and supplies is sold to other utilities, and 36% included in rate base.

Replacement Power Costs:

Pilgrim Trend Case:

= Average Award Group Bid; from John Whippen, Manager, Energy Resource Planning & Forecasting, Boston Edison, Letter to RFP Respondents, October 13, 1987.

National Trend Case:

= Estimated average bid from next 764 Mw supply block after Award Group.

= RFP Ceiling Price - ((RFP Ceiling Price - Average Award Group Bid)

x ((Average Supply Block Ratepayer Benefit Score - 1) / (Average Award Group Ratepayer Benefit Score - 1)))

The average Ratepayer Benefit Score of the Award Group was 1.31; the average Ratepayer Benefit Score of the next 764 Mw supply block was 1.22. Each year, the supply block price was assumed to capture 22/31 of the benefits of the award group, or 70.9% of the difference between the ceiling price and the Award Group.

RFP Ceiling Price from John Whippen, Letter to RFP Recipient, February 19, 1987.

Ratepayer Benefit Scores from Frank McCall, Letter, October , 1987.

Pilgrim Trend Case:

= Estimated average bid of the entire 1327 Mw of acceptable QFs not in the Award Group. Calculated as above. Average savings = 52.4% of Award Group.

Present Value:

The calculation of present value of a future cash stream discounts future cash flows to reflect the time value of money. A dollar in hand today is worth more than a dollar next year, by the amount of interest that could be earned (or the interest payments that could be deferred) by having the dollar for the year's time.

Discount rate = 10.55%, from BECO Exhibit 1.

Appendix B

MASSPIRG NUCLEAR COST ESTIMATES

A. Capital additions

Nuclear plants have required steadily increasing capital additions in order to replace worn-out parts and meet new safety standards. On average nuclear capital additions have increased at 13 percent a year since 1970, after adjusting for inflation (Figure 14). Replacement of some reactor parts, such as cracked pipes in Boiling Water Reactors (BWRs) like Pilgrim, and steam generators in Pressurized Water Reactors (PWRs), have required as much as $100 million or more per plant.

Pilgrim cost trends were analyzed by a statistical technique called "linear regression analysis." An equation was determined for the straight line that best fits Pilgrim's historical cost pattern, after adjusting for the effects of inflation. To measure national cost trends, this report uses equations developed by the Energy Systems Research Group (ESRG), a Boston- based consulting group that has studied nuclear costs for numerous state regulatory and consumer agencies around the country.[23] ESRG has analyzed nuclear cost trends using "multi-variate regression analysis" -- a technique which relates changes in nuclear costs to a number of factors such as plant type, size, location, vintage (in-service date), and year of operation.

In general, plants with Pilgrim's characteristics have experienced far greater capital additions than the national average. BWR capital additions have escalated faster than at PWRs, for instance, and salt-water cooled plants, like Pilgrim, have experienced more capital additions than fresh-water

Figure 14

NATIONAL AVERAGE CAPITAL ADDITIONS

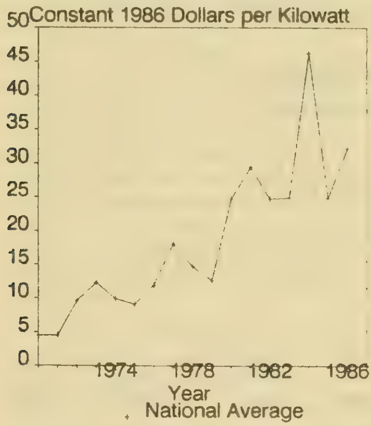


Figure 15

PILGRIM & NAT. AVG. CAPITAL ADDITIONS

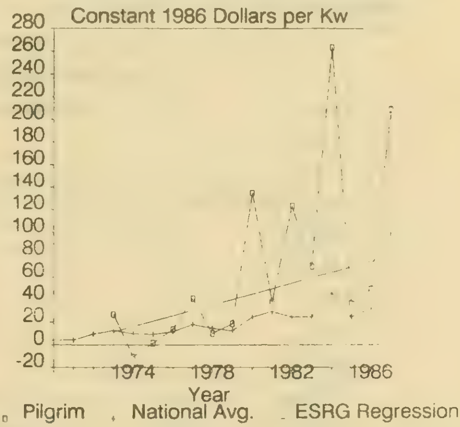
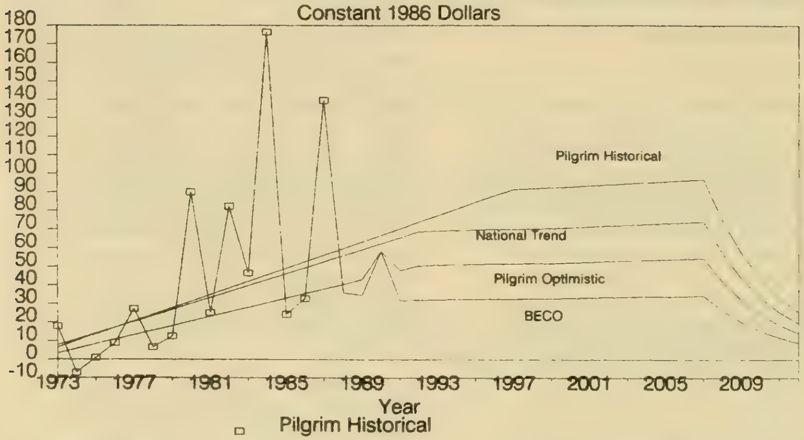


Figure 16

CAPITAL ADDITIONS PROJECTIONS



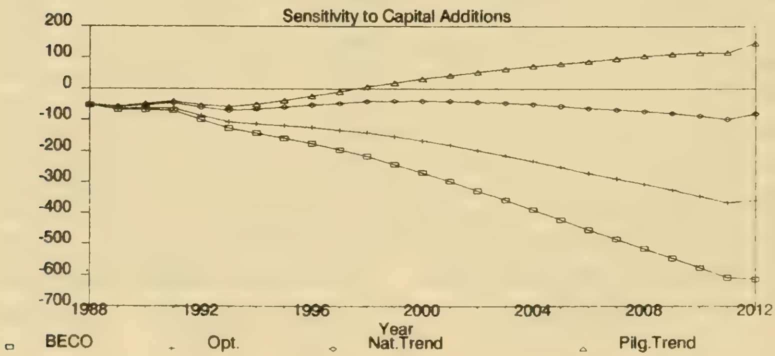
cooled plants. ESRG's regression analysis has found that capital additions are related to plant size, type, cooling water, age, year of initial operation, and whether a plant has one or two units at a site.

Capital additions at the Pilgrim plant have been among the highest of any U.S. nuclear plant. Total Pilgrim capital additions over the period of 1972 to 1986 were 3.3 times the national average per kilowatt, and considerably higher than the regression line for plants of the same characteristics (Figure 15).

Figure 16 displays alternative projections of future Pilgrim capital additions. Except for one moderately

Figure 17

CUMULATIVE SAVINGS FROM RETIRING PILG.



expensive repair planned for 1990, Edison forecasts several years of declining real expenses for capital additions, followed by a steady outlay of less than $30 million a year through the year 2007. Capital additions are estimated to decline by 20 percent per year over the last five years of the plant's life. Even Boston Edison appears to have little confidence in its capital additions estimates, however:

> We have provided a reasonable estimate of Pilgrim's costs for the next 25 years. However, as you know, many factors external to the company, such as NRC mandated modifications, can significantly impact Pilgrim's costs.[24]

MASSPIRG's optimistic projection of Pilgrim capital additions starts with the assumption that the four years with the highest capital additions (1980, 1982, 1984, 1987) were caused by unique events -- such as the replacement of cracked recirculation pipes in 1984 -- which will not recur. The remaining years still show a consistent underlying pattern of capital additions increases which is likely to persist into the future. To be ultra- conservative, the Optimistic Case here assumes that this trend continues only for another five years. Capital additions are also conservatively assumed to decrease over the last five years of the plant's life, even though other utilities have testified that a higher rate of capital additions may be needed to keep them running. (See Appendix B.) Edison's estimate for 1990 capital additions is assumed to represent a particular planned expenditure which is included in MASSPIRG's Optimistic Case as well.

The National Trend Case assumes that Pilgrim's rate of capital additions declines to the level described by the ESRG regression equation, and continues at that rate for five years. The Pilgrim Trend case assumes that capital additions continue at their historic rate (with 1984 and 1987 additions still defined as nonrecurring costs) for 10 years.

Figure 17 illustrates the effect of changing only the assumption about future capital additions, holding all other BECO assumptions the same. If Pilgrim capital additions were to follow the National Trend (an improvement from the historical performance of the plant), it would cost ratepayers very little to retire the plant, even assuming full payment of Pilgrim sunk costs, including a profit.

B. Operation and maintenance costs

Like nuclear capital additions, operation and maintenance (O&M) costs have also been increasing over time, at an average rate of 11.4 percent a year for the nuclear industry as a whole. At Pilgrim, total O&M costs have in-

Figure 18

PILGRIM VS. NATIONAL AVG. O&M COSTS

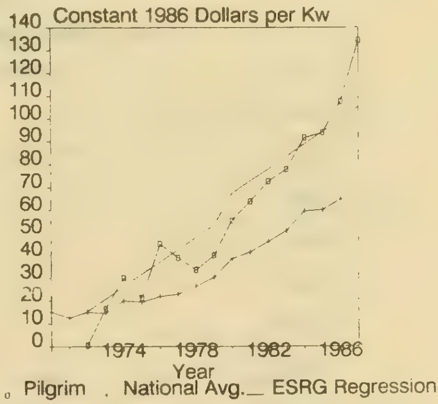
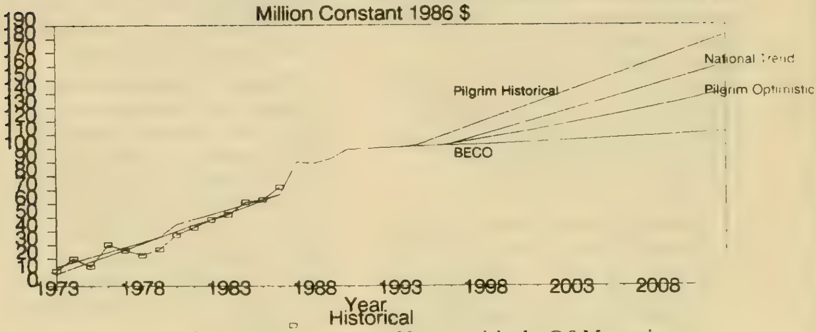


Figure 19

O&M COST PROJECTIONS

Million Constant 1986 $



creased at an annual rate of 13.8 percent, after inflation. Total Pilgrim O&M expenditures between 1972 and 1986 have exceeded the national average per kilowatt by 78 percent. Pilgrim O&M expenses were *less* than the regression line for plants with Pilgrim's characteristics until 1983, however (Figure 18). Figure 18 suggests that management decisions to defer maintenance in the early years of Pilgrim operation may have contributed to some of the plant's later problems.

Not surprisingly, O&M cost increases are correlated with many of the same variables as capital additions -- plant size, age, number of units at a site, and salt-water cooling. After the Three Mile Island Accident in 1979, O&M costs increased at all plants by an average of $8.55 per kilowatt. In addition, plants located in the northeast have had O&M costs averaging about $8 per kilowatt above plants in other regions.

Figure 20

CUMULATIVE SAVINGS FROM RETIRING PILG.

Sensitivity to O&M Costs

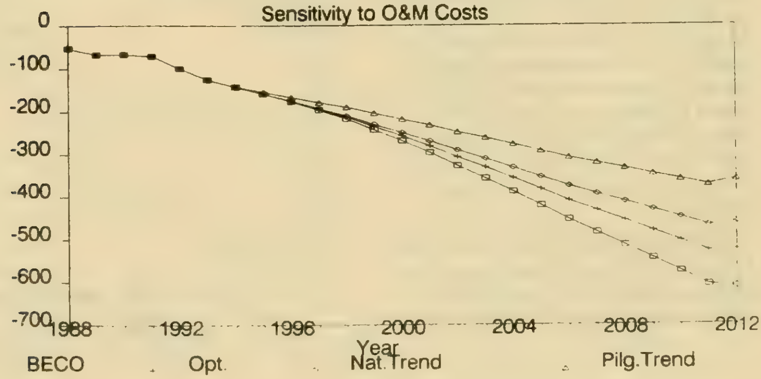
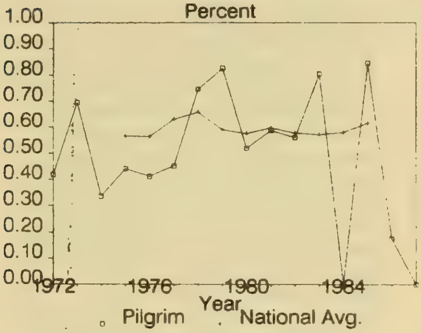


Figure 21

HISTORICAL CAPACITY FACTORS



Alternative projections of O&M costs are shown in Figure 19. Edison projects substantial increases in O&M costs over the next several years, compared to both Pilgrim and national trends. A portion of the near-term O&M costs also includes replacement power costs during extended Pilgrim shutdowns that customers are expected to pay over several years.[25] After 1990, however, BECO projects that real O&M costs, like capital additions, will stabilize in constant dollars, increasing at only 0.5 percent per year.

The MASSPIRG Optimistic Case projects O&M costs increasing at only two percent a year, after adjusting for inflation, after 1994. The National Trend and Pilgrim Trend cases assume that O&M costs eventually resume their historical pattern of increase.

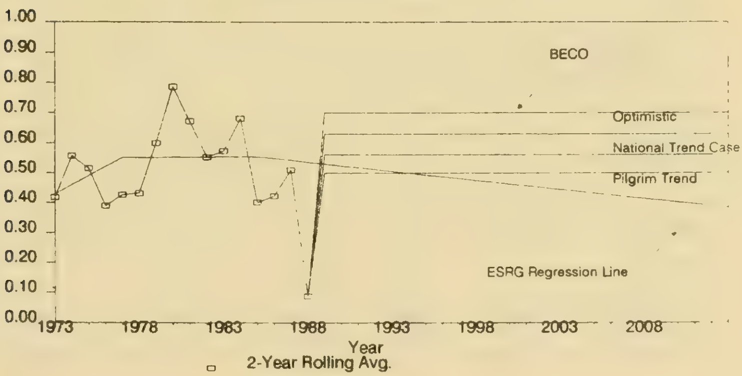
Figure 20 displays the effect of changing only the O&M assumption on cumulative savings from retiring Pilgrim. While significant, the overall impact is not as large as that from changing capital additions assumptions.

C. Capacity factor

The best measure of nuclear plant performance is capacity factor -- roughly, the percentage of time a plant is in-service at full power. The capacity factor of a given plant reflects periods that it is shut down for refueling, maintenance and repair. It also accounts for times when plants may be forced to

Figure 22

CAPACITY FACTOR PROJECTIONS



operate at reduced power levels.

Capacity factors of individual nuclear plants tend to vary a great deal from year to year, particularly since most plants are refueled every other year, and may be taken out of service for several months during that time. Across the entire industry, however, nuclear capacity factors have tended to average consistently just under 60 percent.[26] Pilgrim's lifetime capacity factor to date is only 50 percent. At the point it was shut down in April, 1986, the plant had averaged a capacity factor of 56 percent (Figure 21).

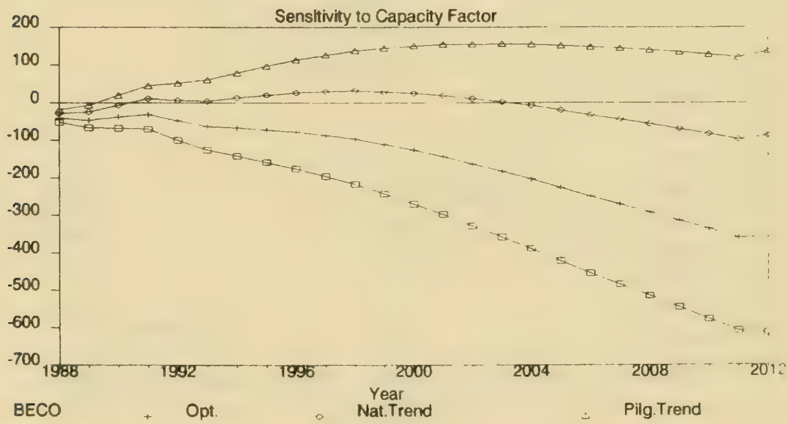
Some varieties of nuclear plants have averaged better performance than others. Between 1975 and 1985, for example, Pressurized Water Reactors (PWRs) averaged capacity factors of 60.8 percent, compared to only 56.6 percent for Boiling Water Reactors (BWRs) like Pilgrim. Smaller plants, however, have generally achieved higher capacity factors than larger plants. Capacity factors of BWRs between 400 Mw and 799 Mw, excluding the Pilgrim plant, averaged 63.2 percent between 1976 and 1986.[27]

ESRG's regression analysis describes capacity factor as a function of plant size, general type, type of cooling water and steam system, and plant age. It shows that nuclear plants have generally tended to increase capacity factors over their first four years of operation, and experience only slight gains in performance over the subsequent eight years. Reactors that are cooled with salt water, like Pilgrim, have tended to decline in performance each year.

Figure 22 illustrates ESRG's regression equation forecast for a plant of Pilgrim's characteristics, and the capacity factor projections used in the three alternative Pilgrim cost scenarios. A two-year rolling average of Pilgrim's historical capacity factor is also shown. Averaging each year's capacity factor with the previous year's helps to smooth out the year-to-year ups and

Figure 23

CUMULATIVE SAVINGS FROM RETIRING PILG.



downs in capacity factor caused by refueling shutdowns every other year.

Boston Edison assumes that Pilgrim will operate at a 70 percent capacity factor over the remainder of its life. Pilgrim's lifetime capacity factor of 50 percent ranks 79th among 94 nuclear plants.[28] The probability of Pilgrim moving from the bottom fifth to well above the average capacity factor is quite low, particularly in light of the trend of declining capacity factors in salt-water cooled reactors.

A 63.2 percent capacity factor -- the national average for small BWRs excluding Pilgrim -- is used in MASSPIRG's Optimistic Case. A 56 percent capacity factor -- equal to Pilgrim's performance before the 1986 shutdown and the peak capacity factor predicted by the regression equation -- is used in the National Trend Case. Finally, the Pilgrim Trend case assumes that the plant will continue to average a 50 percent capacity factor over the rest of its life. These estimates all conservatively assume that the declining performance of salt-water cooled reactors shown by ESRG's regression equation will not continue.

Most of the costs of owning and operating a nuclear plant are "fixed costs" which do not vary with how much electricity the plant actually produces in a given year. The total cost of operating Pilgrim over the next 25 years therefore does not vary much with capacity factor. A lower capacity factor means that more energy would have to be purchased to replace Pilgrim, however, and means a higher cost for each Kwh generated by Pilgrim.

Figure 23 illustrates the impact of capacity factor on the economics of retiring Pilgrim. Even if Pilgrim were able to maintain the 56 percent capacity factor it achieved before its April 1986 shutdown, it would save ratepayers money through the year 2003 to retire the plant, even if all other BECO assumptions hold.

Appendix C
Causes of Nuclear Cost Escalation

The continuing existence of the factors that have contributed to past escalation of nuclear capital additions and operations and maintenance costs make it likely that those expenses will continue to escalate at historic rates for the foreseeable future. The forces driving the cost escalation include the persistence of unresolved safety issues, ongoing technical problems that are discovered as the nuclear industry gains more operating experience, and the aging of reactor components. In addition to increasing costs, premature aging problems also cast serious doubt on whether the Pilgrim plant could be operated for a 40-year lifetime, as Boston Edison projects.

1. Unresolved generic safety issues.

The Nuclear Regulatory Commission maintains a list of unresolved safety issues which are generic to nuclear power reactors. As these issues are resolved, they frequently require significant new expenses to implement them.

Before the 1979 accident at Three Mile Island (TMI), the NRC had resolved 20 of 142 issues identified in its 1978 Task Action Plan, according to a 1984 General Accounting Office report.[29] The TMI accident added many new issues to the Commission's list, and postponed action on many of the previously identified problems. By July 1984, the agency had resolved only 208 of 482 total issues identified through that time. Moreover, new issues were being identified at the rate of 11 per year, while the agency's schedule called for the resolution of only 12 total issues per year. As of August, 1987, 163 issues remained on the unresolved issues list.[30]

New generic issues are likely to be discovered as a result of operating experience, particularly as reactors age. The possibility of additional major nuclear accidents also contributes to the likelihood of new regulations. The NRC staff has estimated that the probability of a full core melt accident at a U.S. nuclear plant may be as high as 45 percent during the next 20 years.[31] Other analysts have estimated the probability to be higher.

One unresolved safety problem that is of particular concern to Pilgrim is the strength of the containment shell which is designed to prevent release of radioactive materials to the environment in the event of an accident. An NRC task force has estimated that the probability of failure of the Mark I containment design used Pilgrim and 25 other U.S. plants may be as high as 90 percent in some accident scenarios, compared to a failure probability of about 10 percent with other containment designs.[32]

30

Another commission task force is currently studying the Mark I problem, but is not expected to make recommendations for more than a year. There is a substantial probability that fixing the Mark I containment problem will impose costs exceeding current BECO estimates.

2. Ongoing technical problems.

There is persistent evidence that nuclear technology has not yet "matured," and that reactor operation will continue to be plagued with safety- related and non-safety related problems that reduce capacity factor and require new O&M and capital additions expenditures to fix. The number of Licensee Event Reports (LERs) -- which document mishaps at nuclear plants -- has steadily increased. In 1986, there were 2,957 LERs filed with the NRC, approximately the same as the record 2,997 LERs for 1985, and well above the 2,435 LERs reported in 1984.[33] Nuclear plant capacity factors have failed to increase as the nuclear industry predicted they would as plants matured.

3. Aging of reactor components.

The need to replace worn plant components and systems has greatly outpaced industry expectations. A 1984 NRC staff report identified 5,893 events in safety-related systems occurring between 1969 and 1982 (17 percent of all LERs) as age-related. Additional aging problems have occurred in non- safety-related systems. Aging problems have been caused by wear and tear, corrosion, internal and external radiation contamination, contact, vibration, stress corrosion, erosion, and a category of miscellaneous problems.[34]

As discussed in the text, salt-water cooling systems at reactors located on oceans, such as Pilgrim, have been associated with more corrosion than fresh-water systems. In addition, the Pilgrim plant has been subject to much higher levels of radiation contamination that many other nuclear plants. The average Pilgrim worker was exposed to 1949 rems a year between 1984 and 1986, compared to 645 rems per year at Millstone I, in Connecticut, a plant the same type and about the same age as Pilgrim.[35]

4. Nuclear plant lifetimes.

In addition to causing increasing costs for replacement of parts and operation and maintenance expenses, reactor aging casts serious doubt on the ability of nuclear plants to operate for the 40 year period assumed by Edison in its evaluation of Pilgrim economics.

Boston Edison's operating license for Pilgrim currently expires in 2008, after 35 years of operation. The utility has recently applied for an extension of its license to the year 2012. No license extensions for any nuclear plants have yet been considered or granted by the NRC, however, and there is no way at this time of predicting whether such extensions will be granted in the future.

Niagara Mohawk Corporation, the chief owner and operator of the Nine Mile Point 1 nuclear plant, requested permission from the New York State Public Service Commission to use a depreciation life of the plant that is five years *shorter* than the plant's operating license.

Recognizing the regulatory pressures from the Nuclear Regulatory

Commission, relicensing should not be assumed. If it should happen that it is possible to relicense the plant, the capital expenditures required would be of such a magnitude that the unit, for depreciation purposes, should be considered as being new at that time.[36]

Niagara Mohawk's testimony, in addition to contradicting BECO's assumption of relicensing, also contradicts Edison's assumption that capital additions expenditures would not increase in real terms over the entire last 25 years of the plant's projected life, and would decrease at 20 percent per year over the last five years.

To date, no commercial nuclear plant has yet operated for longer than 27 years (Table 4), and a significant number of reactors have been retired with considerably fewer years of operation. (Table 5)

Table 4. OLDEST U.S. OPERATING NUCLEAR REACTORS

Plant	Location	Initial Operation	Age	Capacity
Yankee	Rowe, MA	1960	27	185
Big Rock Point	Charlevoix, MI	1962	25	75
San Onofre 1	San Clemente, CA	1967	20	450
Haddam Neck	Haddam Neck, CT	1967	20	600
Oyster Creek	Forked River, NJ	1969	18	550
Nine Mile Point1	Scriba, NY	1969	18	642
Ginna	Ontario, NY	1969	18	517
Dresden 2	Morris, IL	1970	17	794
Robinson 2	Hartsville, SC	1970	17	769
Point Beach 1	Two Creeks, WI	1970	17	485
Millstone 1	Waterford, CT	1970	17	660

Source: Critical Mass Energy Project;[33] Nuclear Regulatory Commission

Table 5. RETIRED U.S. REACTORS

Plant	Initial Operation	Retirement Year	Age	Capacity
Three Mile Island 2	1978	1979	1	906
Pathfinder	1966	1967	1	66
Hallam	1963	1964	1	256
Piqua	1963	1966	2	45
CVTR	1963	1967	3	65
Bonus	1964	1968	4	50
Elk River	1963	1968	4	22
Fermi 1	1966	1972	6	61
Peach Bottom 1	1967	1974	8	40
Indian Point 1	1962	1974	12	265
Humboldt Bay	1963	1976	13	65
Dresden 1	1960	1978	19	207

Notes

[1]A federal study estimated subsidies for research and development, mining and fuel enrichment at almost $40 billion by 1981. (Joseph Bowring, "Federal subsidies to Nuclear Power," unpublished report, Office of Economic Analysis, Energy Information Administration, March 1980. Another estimate of construction subsidies to nuclear power plants runs as high as $15.6 billion for the year 1984 alone. (H. Richard Heede, Richard E. Morgan, and Scott Ridley, *The Hidden Costs of Energy: How Taxpayers Subsidize Energy Development*, Center for Renewable Resources, Washington, D.C., October, 1985)

[2]See *Nuclear Waste Fee Adequacy: An Assessment*, U.S. Department of Energy, Office of Civilian Radioactive Waste Management, DOE/RW- 0020, June 1987, pp. 7-10; *Commercial Nuclear Power: Prospects for the United States and the World*, U.S. Department of Energy/Energy Information Administration, DOE/EIA-0438(86, p. 20); "Nuclear Power Plant Decommissioning: Cost Estimation for Power Planning and Ratemaking," Energy Systems Research Group, Boston, July, 1987.

[3]Charles Komanoff, *Power Plant Cost Escalation*, Komanoff Energy Associates, New York, 1981.

[4]David Schlissel, "Trends for Nuclear Capital Additions and O&M Costs," Direct Testimony Before the Public Service Commission of the State of Missouri Appearing for the Office of the Public Counsel, Case No. ER-85-128, Case No. EO-85-185, June 28, 1985.

[5]*Nuclear Plant Cancellations: Causes, Costs and Consequences*, U.S. Department of Energy/Energy Information Administration, DOE/EIA-0392, April 1983.

[6]Schlissel, *op. cit.*

[7] Richard Hellman and Caroline J.C. Hellman, *The Competitive Economics of Nuclear and Coal Power*, Lexington Books: Toronto, 1983.

[8]Richard McCormack, "Whoops!" *Energy Daily*, April 28, 1986, p. 1

[9]Joseph Kriesberg, *Nuclear Power: Too Costly to Continue*, Draft, Critical Mass Energy Project, Washington, D.C., November 1987

[10]*Ibid.*, from U.S. Department of Energy communication.

[11]Schlissel, *op. cit.*

[12]William Blundell, "Doubts Pervade Nuclear Fuel Industry: Utility Pacts Unclear; Uranium Producers Ailing," *The Wall Street Journal*, October 10, 1985; Kennedy Maize, "Domenici's Uranium Bill Would Trim imports to 50 Percent of U.S. Needs," *The Energy Daily*, February 20, 1986.

[13]*Power to Spare: A Plan for Increasing New England's Competitiveness Through Energy Efficiency*, New England Energy Policy Council, July 1987.

[14]*Final Report of the Boston Edison Review Panel*, March 1987.

[15]*NEPOOL Forecast Report of Capacity, Energy, Loads and Transmission 1987- 2002*, New England Power Pool, West Springfield, MA, April 1, 1987.

[16]Boston Edison, *Request for Proposals from Qualifying Cogeneration and Small Power Production Facilities*, Appendix C, Exhibit 4, p. 18.

[17]NEPOOL, *op. cit.*

[18]*Final Report: Asset Disposal and Contract Settlement Associated With Pilgrim 2 Cancellation*, Boston Edison Company, Report #10, May, 1987.

[19]*Western Massachusetts Electric Company*, D.P.U. 84-25.

[20]*Western Massachusetts Electric Company*, D.P.U. 85-270

[21]*Nuclear Plant Cancellations, op. cit.*

[22]Harvey Salgo, Raymond Czahar, and Paul Raskin, "Proposal of the Executive Office of Energy Resources, D.P.U. 86-36, April 4, 1986.

[23]Equations for this study were taken from the Testimony of Stephen Bernow on "Excess Capacity and Cost Benefit Analysis of Vogtle Generating Station" on behalf of the Georgia Office of Consumers' Utility Counsel before the Georgia Public Service Commission, Docket No. 3673-U, August, 1987.

[24]Carl Gustin, Vice President, Corporate Relations, Boston Edison, Letter to Sharon Pollard, Secreatary of Energy Resources, Commonwealth of Massachusetts, June 8, 1987. Also referred to as Exhibit 1. Exhibit 2 is Carl Gustin letter of July 1, 1987..

[25]Gustin, personal communication, October 1987.

[26]ESRG; *Equipment Availability Report 1976-1985*, North American Electric Reliability Council, Princeton, NJ.

[27]*Ibid.*

[28]From Monthly Operating Reports filed with the U.S. Nuclear Regulatory Commission, courtesy of Stephanie Murphy, Nuclear Information and Resource Service, Washington, D.C.

[29]"Management Weaknesses Affect Nuclear Regulatory Commission Efforts to Address Safety Issues Common to Nuclear Power Plants," General Accounting Office, GAO/RCED-84-19, September 19, 1984).

[30]"Efforts to Ensure Nuclear Power Plant Safety Can Be Strengthened," General Accounting Office, GAO/RCED-87-141, August, 1987.

[31] NRC Testimony to U.S. House of Representatives, Subcommittee on Energy Conservation and Power, April 1986.

[32]Brian Jordan, "Denton Urges Industry to Settle Doubts About Mark I Containment," *Inside N.R.C.*, June 9, 1986, p. 1.

[33]Joshua Gordon, *1986 Nuclear Power Safety Report*, Public Citizen, Washington, D.C., September 1987.

[34]"Survey of Operating Experience from LERs to Identify Aging Trends, Status Report," Nuclear Regulatory Commission, NUREG/CR-3543, January 1984.

[35] David Wessel, "Pilgrim and Millstone, Two Nuclear Plants, Have Disparate Fates," *The Wall Street Journal*, July 28, 1987., p. 1.

[36] John S. Ferguson, Prepared testimony on behalf of the Niagara Mohawk Power Corporation in New York Public Service Commission Case #28225, p. 27.

The CHAIRMAN. In one of the reports you talked about the subject of advance public information and education. And there are some that would say that those people claim not to know the evacuation procedures, that they are against the plan anyway, so it is not their interest to be helpful; that it is not in their interest to tell you, even if they read the plan, that they had read the plan, if they thought they would be helpful to Boston Edison. How do you respond to that criticism? That is a criticism that may be made.

Ms. SHIMSHAK. Having participated in a survey, people gave us very honest answers. I believe that they told you the truth when they said they didn't really know what to do in the event of an emergency and they said they hadn't actually received the emergency information booklet in the mail.

One thing that did stand out with people's answer to these questions is an air of cynicism. Having been through 15 years worth of history of this plant, and seeing how many problems it has and experiencing the NRC's lack of attention to those plans—those problems, I think people have a very cynical view. And even if they were given proper instructions, my guess is they wouldn't follow them. They'll get together with their families because that's what's most important to them and they'll do what they think is best at the moment, and I don't believe that that will be following the prescribed directions.

The CHAIRMAN. Are you, from your own perspective, optimistic or pessimistic as to whether that plant will restart?

Ms. SHIMSHAK. Well, I would be tempted to say that I'm pessimistic just because of the NRC's record in the past, and given the fact that they never really shut a plant down for being as bad as Pilgrim is. But I must admit, I'm feeling optimism for two reasons, and one is that you've taken an interest in this plant, as well as many other elected officials, and, hopefully, that will stimulate some good action on this; and also since the plant has been shut down for 21 months, which I don't believe any of us would have expected in 1986 when it originally closed down.

The CHAIRMAN. Thank you very much—you're a very helpful panel, these are helpful reports. Wish we had more time to go into the issues. I may want to submit some more questions to you, but we appreciate the time. We are very much impressed—but not surprised—by the quality of the representation of the member of the great general court, the State Senate. By your testimony obviously—as well as Mr. Malaguti's testimony, and the very exemplary work that has been done. I want to thank all of you very much.

[One-minute break.]

The CHAIRMAN. I want to announce for the record, we were not able to include all the State Representatives and Senators in the course of our hearing. We had about 10 or 12 that had made applications. We want to indicate to any of those that want to have their statements made a part of the record, including the State senator that represents the local community that we will include them.

We tried to get the State representative, the Board of Selectmen and the chairman of the Energy Committee in the Great General Court. But we want to indicate to everyone, if they want their statement included in the record, we will keep the record open. But

it was really a question of trying to hear from as many of the different representatives who have interest and responsibilities in the local community, from the local representatives as well as the representatives of the NRC.

We wanted to hear all of them and not to try to go below a 3 or 4 minutes presentation; otherwise, you lose the real context of the hearing. So those are the reasons, quite frankly. We were not intending to be disrespectful to any of those persons.

We are particularly delighted now to have here an old friend of mine, and one of our very fine public servants, the Lieutenant Governor of our State, Evelyn Murphy. I welcome her to our hearing as the second ranking State official in a position of responsibility in the State for its health and well being, as she brings a special perspective to this hearing, and we very much look forward to her testimony. I'll ask that you be good enough to stand and take the oath.

[Lieutenant Governor Murphy sworn.]

STATEMENT OF LT. GOV. EVELYN MURPHY

Lieutenant Governor MURPHY. Thank you Senator Kennedy. I want to thank you for giving all of us the opportunity to come here tonight and discuss the Pilgrim nuclear power plant and the serious public health and safety questions surrounding it. And you've seen the turnout tonight on one of the coldest nights of this winter, it is the testimony to the intense feelings that people have about the issue.

I come here tonight, not just as Lieutenant Governor, but as the Acting Governor to express the Governor's and my concern about the threat to the public's health and safety of this plant, and insist on behalf of the people of the Commonwealth of Massachusetts upon two very reasonable specific actions.

First that the NRC hold an adjudicatory hearing in Plymouth before this plant opens; and second, that Pilgrim not be allowed to reopen until the emergency evacuation concerns of both FEMA and Governor Dukakis have been satisfactorily resolved.

In June of 1986, the plant was closed because of serious charges concerning the safety of the management facility. I won't dwell on the specifics. You are going to hear from a panel of State officials here tonight: Mr. Agnes, the Assistant Secretary of Public Safety; Commissioner of Public Health, Deborah Prothrow-Smith; Attorney General; Secretary Pollard, all prepared to supply in detail from the State's perspective, the concerns that Governor Dukakis and I share.

Since the closing of this facility, Governor Dukakis has laid out three preconditions for its reopening. Public health and safety are the crux of these criteria. First, the inadequate safety practices at the plant must be corrected; second, the management problems must be resolved, and third, the evacuation plan must be adequate. These three criteria have been offered as reasonable demands for the operation of the nuclear power plant in a heavily populated area. They have not yet been met by Boston Edison.

This administration has the responsibility to protect our citizens. And our insistence that the plants be operated with protection of

people's health and safety as the foremost guarantee is absolutely non-negotiable.

My own reservations about this plant and nuclear power date back to 1975 when I rejected the draft Environmental Impact Report for Pilgrim 2. At that time the comments were on the questions of disposal of waste and about plant safety. Those issues are the same, and remain unanswered today. So my reservations have become more resolutions: the resolve to prevent our safety and economic health from being held hostage to any one power source; and the resolution to work toward the development of safe, reliable, non-nuclear energy.

As you deliberate here tonight on the future of the Pilgrim plant, please disregard the issues involved in supply and demand on the New England power grid. Let me be very clear. We have sufficient energy generating capacity for all but the most unusual situations today. As a matter of fact, Tuesday night, demand hit a record-breaking peak of 18,471 megawatts, that was met through contingency purchases and other standard operating procedures, once we hit those contingency plans. So meeting even high electricity demands is possible without Pilgrim, without Seabrook and without a crisis.

Today's problems of tight energy in New England are more due to the lack of judicious management and maintenance practices, as well as the needs of aggressive action on short term augmentation of supplies, as was just discussed by the panel; some of the small scale power that could be brought on line quickly, and some of the energy conservation load management practices that have certainly been recommended and are possible.

In recent months, the State has been very active to do this, and we're pulling together a task force, at the Governor's request, so the state can move aggressively on these initiatives to augment supply and dampen demand. So we are doing that. And I would only say to you that I would hold that question about the New England power supply aside. It has no relevancy whatsoever tonight.

Having expressed these concerns to you, I must say that I realize how difficult it is for you, Governor Dukakis, me and other responsible public officials to make any headway against an unresponsive Federal bureaucracy, which actually doesn't seem to care about the health and safety of the citizens of the State.

It seems to me that the NRC has been surprisingly nonresponsive to date. Let me be more specific, and go through a little bit of the sequence here. In July of 1986, as Senator Golden mentioned, I joined him, MASSPIRG, and many other in signing that show cause petition for addressing three points on nuclear reactor safety, emergency planning and maintenance. The NRC rather callously dismissed the first two and deferred consideration on the third point. MASSPIRG appealed denials, and Attorney General Shannon, who is about to testify after me, is now an intervenor in those appeals. And yet there has been no response. I find this difficult to accept.

In October of 1987, Governor Dukakis and Attorney General Shannon filed a show cause petition asking for the adjudicatory hearings on whether this plant should be allowed to reopen. There has been no response. Nor has the NRC responded to a substan-

tive—in a substantive manner—to the two reports on Pilgrim prepared by Secretary of Public Safety Charles Barry, and submitted by Governor Dukakis at first on December 1, 1986; the second December of 1987. And it is now my understanding, Senator, you and Congressman Studds also submitted a request that has been denied in term of appeal to an adjudicatory hearing.

NRC has indicated that it will meet with petitioners, and this, I believe, for all of us is unacceptable. Citizens of the State have a right to see this case argued in a formal setting. I would encourage you to do everything in your power to see that this hearing takes place. You have my commitment and the Governor's commitment to fully support your efforts.

What the Governor and the people of Massachusetts have put before the NRC, we believe to be specific and reasonable requests, but when confronted by bureaucratic stonewalling, that reasonableness is likely to turn out to be more increasing outrage.

In closing, let me make one final point regarding FEMA and the NRC. As you know, currently FEMA's role is strictly advisory. This has been mentioned several times. The situation here is a prime example of how the NRC could overrule the recommendations of both the Governor and FEMA, as it's own advisory body. This is absurd.

The Governor and I would wholeheartedly support any congressional action that you would take in passing a requirement that the NRC be bound by the recommendations of the State government and of FEMA. For Massachusetts, that would mean that Pilgrim would not restart until the people of Massachusetts were satisfied with the emergency plan.

We thank you once again for doing this tonight and for your involvement and we're really quite grateful.

[The prepared statement of Lieutenant Governor Murphy follows:]

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE DEPARTMENT
STATE HOUSE • BOSTON 02133

EVELYN F MURPHY
LIEUTENANT GOVERNOR

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TESTIMONY OF LIEUTENANT GOVERNOR EVELYN F. MURPHY

UNITED STATES LABOR AND HUMAN RESOURCES COMMITTEE

JANUARY 7, 1988

SENATOR KENNEDY, MEMBERS OF THE COMMITTEE. I WANT TO THANK YOU FOR GIVING US ALL THE OPPORTUNITY TO COME HERE TONIGHT TO DISCUSS THE PILGRIM NUCLEAR POWER PLANT AND THE SERIOUS PUBLIC HEALTH AND SAFETY ISSUES SURROUNDING IT.

THE TURNOUT TONIGHT, ON ONE OF THE COLDEST NIGHTS OF THE WINTER, IS TESTIMONY TO THE FEELINGS PEOPLE HAVE ABOUT THIS ISSUE.

I COME HERE TONIGHT AS ACTING GOVERNOR TO EXPRESS THE GOVERNOR'S AND MY CONCERNS ABOUT THE THREATS TO PUBLIC HEALTH AND SAFETY POSED BY THIS PLANT, AND TO INSIST, ON BEHALF OF THE PEOPLE OF THE COMMONWEALTH OF MASSACHUSETTS, UPON TWO VERY REASONABLE, SPECIFIC ACTIONS. FIRST, THAT THE NRC HOLD AN ADJUDICATORY HEARING HERE, IN PLYMOUTH, BEFORE THIS PLANT OPENS. SECOND, THAT PILGRIM NOT BE ALLOWED TO REOPEN UNTIL THE EMERGENCY EVACUATION CONCERNS OF BOTH FEMA AND GOVERNOR DUKAKIS HAVE BEEN SATISFACTORILY RESOLVED.

IN JUNE 1986, THE NRC AND BOSTON EDISON ANNOUNCED THE TEMPORARY CLOSING OF THE PILGRIM PLANT, BECAUSE OF SERIOUS CHARGES CONCERNING THE SAFETY AND MANAGEMENT OF THE FACILITY. I WILL NOT DWELL ON THE SPECIFICS OF THIS MATTER. MR. AGNES, THE ASSISTANT SECRETARY OF PUBLIC SAFETY AND DR. PROTHROW-STITH, THE COMMISSIONER OF PUBLIC HEALTH, ARE PREPARED TO PROVIDE DETAILED DOCUMENTATION TO YOU AND THE COMMITTEE ABOUT THE CONCERNS GOVERNOR DUKAKIS AND I SHARE.

SINCE THE CLOSING OF THE FACILITY, GOVERNOR DUKAKIS HAS LAID OUT THREE PRECONDITIONS FOR ITS REOPENING; PUBLIC HEALTH AND SAFETY ARE AT THE CRUX OF THOSE CRITERIA.

FIRST, THE INADEQUATE SAFETY PRACTICES AT THE PLANT MUST BE CORRECTED; SECOND, THE MANAGEMENT PROBLEMS MUST BE RESOLVED; AND THIRD, THE EVACUATION PLAN MUST BE ADEQUATE.

THESE THREE CRITERIA HAVE BEEN OFFERED AS REASONABLE DEMANDS FOR THE OPERATION OF A NUCLEAR POWER PLANT IN A HEAVILY-POPULATED AREA. AND THESE THREE CRITERIA HAVE NOT YET BEEN MET BY BOSTON EDISON. THIS ADMINISTRATION HAS THE RESPONSIBILITY TO PROTECT OUR CITIZENS. OUR INSISTENCE THAT THE PLANT BE OPERATED WITH PROTECTION OF PEOPLE'S HEALTH AND SAFETY AS THE FOREMOST GUARANTEE IS ABSOLUTELY NON-NEGOTIABLE..

MY OWN RESERVATIONS ABOUT PILGRIM AND NUCLEAR POWER IN GENERAL, DATE BACK TO 1975, WHEN I SERVED AS SECRETARY OF ENVIRONMENTAL AFFAIRS IN THE FIRST DUKAKIS ADMINISTRATION. AT THAT TIME, I REJECTED THE DRAFT ENVIRONMENTAL IMPACT REPORT FOR PILGRIM II BECAUSE OF UNRESOLVED WASTE DISPOSAL PROBLEMS AND QUESTIONS ABOUT PLANT SAFETY. THESE ISSUES REMAIN UNRESOLVED TO THIS DAY.

SO, MY RESERVATIONS HAVE BECOME RESOLUTIONS: RESOLUTION TO PREVENT OUR SAFETY AND ECONOMIC HEALTH BEING HELD HOSTAGE TO ANY ONE POWER SOURCE; AND RESOLUTION TO WORK TOWARD THE DEVELOPMENT OF SAFE, RELIABLE, NON-NUCLEAR ENERGY.

AS YOU DELIBERATE ON THE FUTURE OF THE PILGRIM PLANT, PLEASE DISREGARD THE ISSUES INVOLVING SUPPLY AND DEMAND ON THE NEW ENGLAND POWER GRID. LET ME BE VERY CLEAR: WE HAVE SUFFICIENT ENERGY GENERATING CAPACITY FOR ALL BUT THE MOST UNUSUAL SITUATIONS. AS A MATTER OF FACT, TUESDAY NIGHT, DEMAND HIT A RECORD-BREAKING PEAK OF 18,471 MW, AND WAS MET THROUGH CONTINGENCY PURCHASES AND OTHER STANDARD OPERATING PROCEDURES. SO, MEETING EVEN UNUSUALLY HIGH ELECTRICITY DEMANDS IS POSSIBLE WITHOUT PILGRIM, WITHOUT SEABROOK, AND WITHOUT CRISIS.

TODAY'S PROBLEMS OF TIGHT ENERGY IN NEW ENGLAND DERIVE FROM LACK OF JUDICIOUS MAINTENANCE SCHEDULING AND PRACTICE; A LACK OF AGGRESSIVE PERFORMANCE TO EASE DEMAND THROUGH CONSERVATION AND LOAD MANAGEMENT: AND A LACK OF STRONG PURSUIT OF SMALL SCALE POWER PLANTS TO AUGMENT SUPPLY.

IN RECENT MONTHS THE STATE HAS BEEN VERY ACTIVE. THE GOVERNOR HAS ASKED ME TO WORK WITH SECRETARY POLLARD, SECRETARY GOLD, SECRETARY HOYTE, THE DEPARTMENT OF PUBLIC UTILITIES, THE DEPARTMENT OF CAPITAL PLANNING AND OPERATIONS AND THE GOVERNOR'S ECONOMIC DEVELOPMENT OFFICE SO THE STATE CAN MOVE AGGRESSIVELY ON THESE INITIATIVES TO AUGMENT SUPPLY AND DAMPEN DEMAND. AND WE ARE DOING JUST THAT.

HAVING EXPRESSED THESE CONCERNS TO YOU, SENATOR, I MUST SAY I REALIZE HOW DIFFICULT IT IS FOR YOU, GOVERNOR DUKAKIS, ME AND OTHER RESPONSIBLE PUBLIC OFFICIALS TO MAKE ANY HEADWAY AGAINST AN UNRESPONSIVE FEDERAL BUREAUCRACY, A BUREAUCRACY THAT REALLY DOESN'T SEEM TO CARE ABOUT THE HEALTH AND SAFETY OF THE CITIZENS OF THIS STATE. IT SEEMS TO ME THAT THE NUCLEAR REGULATORY COMMISSION HAS BEEN SURPRISINGLY NON-RESPONSIVE IN DEALING WITH THE MASSACHUSETTS GOVERNMENT AND THE PUBLIC ABOUT THIS FACILITY.

LET ME BE SPECIFIC. IN JULY OF 1986, I JOINED SENATOR WILLIAM GOLDEN, MASSPIRG AND MANY OTHERS IN SIGNING A SHOW CAUSE PETITION ADDRESSING THREE POINTS: REACTOR SAFETY; EMERGENCY PLANNING; AND MAINTENANCE. THE NRC RATHER CALLOUSLY DISMISSED THE FIRST TWO, AND DEFERRED CONSIDERATION OF THE THIRD POINT. MASSPIRG HAS APPEALED THE DENIALS, AND ATTORNEY GENERAL JAMES SHANNON IS NOW AN INTERVENER IN THE APPEAL; YET THERE HAS BEEN NO RESPONSE. I FIND THIS VERY DIFFICULT TO ACCEPT.

IN OCTOBER, 1987, GOVERNOR DUKAKIS AND ATTORNEY GENERAL JAMES SHANNON FILED A SHOW CAUSE PETITION ASKING FOR AN ADJUDICATORY HEARING ON WHETHER THIS PLANT SHOULD BE ALLOWED TO REOPEN. THERE HAS BEEN NO RESPONSE.

NOR HAS THE NRC RESPONDED IN A <u>SUBSTANTIVE</u> MANNER TO THE TWO REPORTS ON PILGRIM, PREPARED BY SECRETARY OF PUBLIC SAFETY CHARLES BARRY AND SUBMITTED BY GOVERNOR DUKAKIS, THE FIRST IN DECEMBER 1986, THE SECOND IN DECEMBER 1987.

AND, SENATOR, I UNDERSTAND THAT THE NRC HAS DENIED THE REQUEST WHICH YOU AND CONGRESSMAN GERRY STUDDS SUBMITTED ASKING FOR AN ADJUDICATORY HEARING ON PILGRIM.

THE NRC HAS INDICATED THAT IT WILL MEET WITH THE PETITIONERS. THIS IS UNACCEPTABLE. THE CITIZENS OF THIS STATE HAVE THE RIGHT TO SEE THIS CASE ARGUED IN A FORMAL SETTING. I WOULD ENCOURAGE YOU, SENATOR, TO DO EVERYTHING IN YOUR POWER TO SEE THAT THIS HEARING TAKES PLACE. YOU WILL HAVE THE GOVERNOR'S AND MY FULL SUPPORT IN YOUR EFFORTS.

WHAT THE GOVERNOR AND THE PEOPLE OF MASSACHUSETTS HAVE PUT FORTH ARE SPECIFIC AND REASONABLE REQUESTS AND SUGGESTIONS. BUT WHEN CONFRONTED BY SUCH BUREAUCRATIC STONEWALLING, A VOICE OF REASON COULD BECOME TRANSFORMED INTO A VOICE OF OUTRAGE. IT IS AN UNCONSCIONABLE ATTITUDE ON THE PART OF A PUBLIC AGENCY SUPPOSEDLY CHARGED WITH PROTECTING PUBLIC HEALTH AND SAFETY.

IN CLOSING, LET ME MAKE ONE FINAL POINT REGARDING FEMA AND THE NRC. AS YOU KNOW, CURRENTLY FEMA'S ROLE IS STRICTLY ADVISORY. HOWEVER, THE SITUATION HERE IS A PRIME EXAMPLE OF HOW THE NRC COULD OVERRULE THE RECOMMENDATIONS OF BOTH THE GOVERNOR OF A STATE AND ITS OWN ADVISORY BODY BY ALLOWING PILGRIM TO REOPEN DESPITE EXPERT OPINION TO THE CONTRARY. THIS IS AN ABSURDITY. THE GOVERNOR AND I WOULD WHOLEHEARTEDLY SUPPORT ANY CONGRESSIONAL EFFORT TO GET LEGISLATION PASSED WHICH WOULD REQUIRE THE NRC TO BE BOUND BY THE RECOMMENDATIONS OF A GOVERNOR AND FEMA.

FOR MASSACHUSETTS, THIS WOULD MEAN THAT PILGRIM WOULD NOT RESTART UNTIL THE PEOPLE OF MASSACHUSETTS WERE SATISFIED WITH THE EMERGENCY PLANS.

THANK YOU.

The CHAIRMAN. Thank you very much. We're grateful for your presence here, for your taking the time.

Let me ask you. Given the Governor's position on the Seabrook and on the Pilgrim, what is the implication, due to the fact that nuclear power provides some 33 percent of the power resources for New England, if Seabrook isn't opened and Pilgrim is not reopened, what are the energy implications going to be in terms of Massachusetts, and responding first of all, and then respond to the point that the legislators made in terms of increasing pressures in term of the growth in the future. How are we going to deal with it?

Lieutenant Governor MURPHY. Well, I think those matters go hand in hand. We have right now sufficient energy on the power grid to respond to even the most extreme matters that we see right now, for instance that we had this summer.

The real issues before us are how to move now to augment our supply. There are lots of proposed plants for small scale cogeneration, hydroelectric, environmentally sound, small scale plants now in the licensing proceedings within the State government—we are looking to expedite those. There is the equivalent of one Pilgrim plant right now within that licensing procedure. So we can see ways in the short term to augment supplies. I think we can also see ways in the short term to dampen some of the demands, conservation and load management procedures, and also to take some action which even includes the planning, which we have been doing the last couple of days, to ask the utility companies to get more aggressive concerning interrupting rate contracts.

So in the short term, Senator, we believe very strongly that there is sufficient power for not only meeting today's demands, but in the short-term summer growth. Over the longer trek, there is no doubt that in the mid 1990's, the Federal Reserve Board study is a wise and sound one, and that we'll need to look at some larger scaled plants to be brought on line. That explains some of the Governor's initiatives around natural gas, and the initiatives right now to look at increased resources from HydroQuebec, and our looking at even Edgar Station.

So we see a way right now of moving from the overreliance of nuclear power to other options, diversifying what we have for all of New England power, which makes us feel safer and insures the kind of reliabilities, so that we can continue to have a sustained economic growth and the jobs that we now enjoy, but it means getting on with this. And I think the faster we can put to rest the controversies of nuclear power and all the other options, the healthier and safer and more reliable our energy sources are going to be.

The CHAIRMAN. I thank you very much. I think in your summation of the three major criteria which are necessary before you and the Governor will support an opening of the plant, you have capsulized the essence of the argument. All the rest of your presentation certainly supports it. I want to thank you very much for——

Lieutentant Governor MURPHY. Thank you.

The CHAIRMAN [continuing]. Joining us. We're grateful for your participation in this matter. Thank you.

Our next witness is our Attorney General Jim Shannon. He is a long-time, personal friend of mine, who was very much involved in the Pilgrim question even before he assumed his present position.

He is an uniquely qualified person. Some of the ramifications of the legal relationships between the State and Federal government in the nuclear power field, this is an issue I know, General, that we heard about earlier in the course of our hearing, but there have been a good deal of comments from a number of witnesses about how this relationship could be adjusted or changed, in order that the principal health concerns and safety concerns and the management concerns can be addressed by the public and by the State officials. So we're enormously interested in your own views on those subjects, as well as what the current state of the situation is, and what actions you are proposing to take should there be a decision to move ahead. We look forward to your testimony, and we'll ask you to be kind enough to stand.

[Attorney General Shannon sworn.]

STATEMENT OF ATTORNEY GENERAL JAMES SHANNON

Mr. SHANNON. Thank you, Senator Kennedy. I want to thank you for holding this hearing this evening, and also for the leadership that you have brought to this very important issue to the people of the Commonwealth and in the U.S. Senate.

The issue before you, the health implications of restarting the Pilgrim nuclear power plant is one of tremendous importance to everybody in the Commonwealth, but particularly to those people who are neighbors to this plant. I commend you, too, for coming here tonight so that the people who have been shut out of the process can finally be heard.

The facts of this case have been very well documented. The NRC currently ranks Pilgrim as one of the worst managed plants in the country. This past summer, the General Accounting Office reported that most of Pilgrim's management deficiencies remained uncorrected. In 1982, the NRC fined Boston Edison $550,000 for submitting false information to the NRC and improperly operating Pilgrim.

By 1985, the utility had paid additional civil penalties totaling $90,000. In fact, between 1983 and 1985, the NRC cited Pilgrim for 52 violations, ranging from operations to surveillance and radiological control. Finally, in April 1986, Boston Edison shut Pilgrim down.

These facts compel an open process, one in which Boston Edison will be required to prove to the public that its problems are solved. Instead, it appears the NRC intends to decide the fate of this plant on the basis of a closed inspection and evaluation.

The people of the Commonwealth deserve better than that. No one should consider reopening the Pilgrim nuclear power plant until there has been a full adjudicatory hearing, which clearly demonstrates that these problems have been solved.

Senator Kennedy, both you and Congressman Studds have been forceful in calling for these hearings. The NRC's response that a public meeting be held is completely inadequate, if we are to insure public health and safety.

In 1986, before my election as attorney general, I was a petitioner along with several others here tonight, calling for a full adjudicatory hearing on the reopening of this plant. As Attorney Gener-

al, I, along with Governor Dukakis, filed a second petition for the same full legal proceeding. The NRC essentially rejected the first, and has yet to act on the second. The private petitioners have appealed the rejection by the NRC, and my office is taking a lead role in that litigation.

I continue to be deeply concerned, not only about the threat this plant poses to public health and safety, but the unwillingness of both the utility and the NRC to address both these issues in an open hearing. The NRC has a formal hearing process and they should use it if they expect to restore public confidence in this powerplant.

These two petitions are straightforward. They call for the NRC to hold a hearing in which Boston Edison must prove it can operate this plant safely and effectively; a hearing in which we can cross examine the company's and the NRC's experts, and offer our own independent experts to review the facts; a hearing in which the NRC must issue a written decision which is subject to review in courts. The public deserves a full hearing on the safety of this troubled nuclear plants. Boston Edison must be held to a burden of proof in an adjudicatory hearing to show that it can operate the plant safely, something which it has yet to prove.

Over the past year as attorney general, I've been deeply involved in the very serious questions surrounding the regulation of the nuclear power industry, both here at Pilgrim and through the licensing process of the Seabrook plant in New Hampshire. Last year, I created a nuclear safety unit in the attorney general's office because it was clear to me that these issues demanded special resources and technical expertise if we were to meet the industry on level ground. I always expected the nuclear industry to be a formidable adversary but what I did not expect to find was the Nuclear Regulatory Commission intent on insulating itself from public participation and public process.

In Seabrook we have seen it evidenced time and time again, but most recently and most blatantly in the Commission's decision to change the rules and attempt to knock Massachusetts out of the licensing process. And on that issue we'll meet the NRC in court. Here at Pilgrim, we see it again in the failure of the NRC to allow a full adjudicatory hearing on the many questions surrounding this troubled plant. Should the NRC reject the Commonwealth's pending petition for enforcement action, then I'm prepared to take that issue to court. The NRC should require a full adjudicatory hearing on these issues. It has, after all, cited the plant repeatedly for its mechanical and safety and management problems.

The issues that have brought you here tonight, the health implications of restarting this plant are both real and deadly serious. We simply cannot allow this federal agency to continue its closed door deliberations on a matter of this magnitude. As Attorney General I will use the full resources of my office to hold this utility and this Commission accountable to the people of the Commonwealth who deserve real answers obtained in a formal public hearing process.

I know, Mr. Chairman, that you and the members of your committee will continue to press the NRC for such a responsible public response.

I would also like to say, Senator Kennedy, that I'm deeply disappointed that the management of Boston Edison has refused to participate in tonight's hearing. They are in this room; they are sitting in the audience. If we are to trust them, they should be at least willing to come forward and state their case to you and to the people of this area.

[Applause]

Mr. SHANNON. I think their management has been characterized by an ostrich-like quality for the last several years. They tell us things have changed. I think their failure to participate tonight raises serious questions as to whether we should trust them, and I hope that they will join us in requesting of the NRC a full process where they can make their case in a way that might restore confidence in management and leave the people of Massachusetts feeling that their health and safety will be adequately protected if Pilgrim is ever to go back on the line.

[The prepared statement of Attorney General Shannon follows:]

TESTIMONY OF
ATTORNEY GENERAL JAMES SHANNON
BEFORE THE SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES
JANUARY 7, 1988

Thank you, Senator Kennedy, for holding this hearing. The issue before you -- the health implications of restarting the Pilgrim Nuclear Power Plant -- is one of tremendous importance to everyone in the Commonwealth, but particularly to those people who are neighbors to this plant. I commend you, too, for coming here tonight so that the people who have been shut out of the process can finally be heard.

The facts of this case have been well documented:

-- The NRC currently ranks Pilgrim as one of the worst managed plants in the country.

-- This past summer, the General Accounting Office reported that most of Pilgrim's management deficiencies remain uncorrected.

-- In 1982, the NRC fined Boston Edison $550,000 for submitting false information to the NRC and improperly operating Pilgrim.

-- By 1985, the utility had paid additional civil penalties totalling $90,000.

-- In fact, between 1983 and 1985, the NRC cited Pilgrim for 52 violations ranging from operations, to surveillance and radiological controls.

-- Finally, in April 1986, Boston Edison shut Pilgrim down.

These facts compel an open process, one in which Boston Edison will be required to prove its public claims that its

problems are solved. Instead, it appears the NRC intends to decide the fate of this plant on the basis of a closed inspection and evaluation. The people of the Commonwealth of Massachusetts deserve better than that. No one should consider reopening the Pilgrim Nuclear Power Plant until there has been a full adjudicatory hearing which clearly demonstrates that these problems have been solved.

Senator Kennedy, both you and Congressman Studds have been forceful in calling for these hearings. The NRC's response that a public meeting be held is completely inadequate if we are to ensure public health and safety.

In 1986, before my election as Attorney General, I was a petitioner calling for a full, adjudicatory hearing on the reopening of this plant. As Attorney General, I filed a second petition for the same, full legal proceeding. The NRC essentially rejected the first and has yet to act on the second. The private petitioners have appealed the NRC decision and my office is taking a lead role in that litigation.

I continue to be deeply concerned not only about the threats this plant poses to public health and safety, but the unwillingness of both the utility and the NRC to address those serious issues in an open hearing. The NRC has a formal hearing process and they should use it if they expect to restore public confidence in this power plant.

These two petitions are straightforward -- they call for the NRC to hold a hearing in which Boston Edison must prove it can operate this plant safely and effectively. -- A hearing in

which we can cross examine company and NRC experts and offer our own independent experts to review the facts. -- A hearing in which the NRC must issue a written decision which is subject to review in the courts.

The public deserves a full hearing on the safety of this troubled nuclear plant. Boston Edison must be held to a burden of proof in an adjudicatory hearing to show that it can operate the plant safely --- something which it has yet to prove.

Over the past year as Attorney General, I have been deeply involved in the very serious questions surrounding the regulation of the nuclear power industry both here at Pilgrim and through the licensing process of the Seabrook Plant in New Hampshire. Last year, I created a Nuclear Safety Unit in the Attorney General's office because it was clear to me that these issues demanded special resources and technical expertise if we were to meet the industry on level ground.

I always expected the nuclear industry to be a formidable adversary. But what I did not expect to find was a Nuclear Regulatory Commission intent on insulating itself from public participation and public process. In Seabrook, we've seen it evidenced time and time again, but most recently and most blatantly in the commission's decision to change the rules -- an attempt to knock Massachusetts out of the licensing process. And on that issue, we will meet the NRC in court.

Here, at Pilgrim, we see it again in the failure of the NRC

to allow a full adjudicatory hearing on the many questions surrounding this troubled plant. Should the NRC reject the Commonwealth's pending petition for a hearing, then I am prepared to take that issue to court.

The NRC should require a full adjudicatory hearing on these issues. It has, after all, cited the plant repeatedly for its mechanical, safety and management problems.

The issue that has brought you here tonight -- the health implications of restarting this plant -- are both real and deadly serious. We simply cannot allow this federal agency to continue its closed door deliberations on a matter of this magnitude.

As Attorney General, I will use the full resources of my office to hold this utility and this commission accountable to the people of the Commonwealth who deserve real answers obtained in a formal public hearing process. I know, Mr. Chairman, that you and the members of your committee will continue to press the NRC for such a responsible, public response.

Thank you.

The CHAIRMAN. Thank you very much, Attorney General Shannon. Let me ask you a few questions. Maybe you can review with us for just a few minutes, what the legal situation is relevant to the State of Massachusetts and the NRC, should the NRC plan to give approval for the start-up of Pilgrim I. What powers reside in you and the state to affect that decision? Maybe you could discuss that for us if you will.

Mr. SHANNON. I'll be happy to. As has been pointed out by previous witnesses, there are really two petitions which have been filed, one which has been essentially rejected by the NRC. The Commonwealth is now involved as intervenor on appeal of that decision. The other one is——

The CHAIRMAN. What is that?

Mr. SHANNON. That is the petition which was put together by MASSPIRG included a number of members of the State legislature, myself, and Lieutenant Governor Murphy, and was filed during the summer of 1986.

In the fall of 1987, I filed on behalf of Governor Dukakis and myself another petition, based on some of the old concerns that we had and some new ones which had been raised about this particular reactor and which had come to light after the Barry report on evacuation planning. We're waiting for a decision from the Nuclear Regulatory Commission on that petition.

If the NRC denies us a hearing after that process, then we'll take that matter to the Federal court, it is our right. There has been some suggestion that the Federal regulation completely preempts state officials from acting to protect the health and safety of the public; well, we don't accept that for a moment. I think that Governor Dukakis, myself, other responsible state officials have implicit authority to act to protect the people of Massachusetts and we're willing to act to protect the people of Massachusetts, and we're willing to assert those arguments in court as well around the Pilgrim plant as we are around the Seabrook nuclear plants.

The CHAIRMAN. You wouldn't draft the law the way it is now?

Mr. SHANNON. That's right, Senator. I think I would be a little clearer about where the Federal Government's authority ends and the States' begins. What is clear though, and I was in the Congress when that legislation was being debated, as were you, and what is clear is that in and post-Three Mile Island era, Congress intended for the States to play a very important role along with the Federal Government to actively protect their own citizens.

As a matter of fact, the premise of all congressional action was that people could not be protected unless the states were included in that process. So I don't yield for a moment to the notion that we, the state officials, do not have the authority to act to protect people from the dangers of a poorly managed or poorly constructed power plant.

The CHAIRMAN. I think that you should know that some of the NRC people are very adamant; they say that they'll be darned if they will let these nuclear powerplants be held hostage to the whims of the states. How do you react to that?

Mr. SHANNON. I've heard that suggestion from some people in the NRC. The notion that that we are acting arbitrarily and capriciously, particularly in this case, is just outrageous.

This is documented to be, by the NRC, one of the most poorly managed nuclear powerplants we have ever seen in the history of nuclear power. As late as just a few months ago, further deficiencies were pointed out in the way in which the Pilgrim nuclear power plant has been run, by the Nuclear Regulatory Commission. They have fined Boston Edison in the past, and yet these deficiencies have not been corrected. Serious questions have been raised about this reactor over the period of the last year, so the notion that we are acting at all arbitrarily or that this plant is being held hostage, is, I think, an affront, and I don't think that the people of the Commonwealth are going to buy that and I don't think people around the country will either.

The CHAIRMAN. You are familiar with the MASSPIRG report on the economic implications of a permanent shutdown of Pilgrim?

Mr. SHANNON. I am.

The CHAIRMAN. Then you know that they conclude that the utility customers would actually save money if that happens; is that right?

Mr. SHANNON. That's right.

The CHAIRMAN. Have any of your people in the attorney general's office looked at that question?

Mr. SHANNON. Yes, Senator, we have looked at the MASSPIRG report. We do find it of real value as part of our evaluation. We are looking at the question of economics at Pilgrim right now. While I can't give you a definitive answer, I can say this. On the basis of the study we have done to date, we have concluded that at best, Pilgrim is now marginally economic. I think of the safety concerns apart from the economics because I don't think that there is any price we can put on the health and safety of the people who live in the areas around nuclear power plants.

[Applause.]

Mr. SHANNON. But apart from the safety concerns that I've got, we must look at those economic questions and I think that when we look at them, we are going to find a lot of what MASSPIRG has said proves to be absolutely correct.

The CHAIRMAN. Is it safe for me to assume that if a decision is to move ahead, that you are going to exercise all the rights as attorney general in every possible way to do everything that you possibly can to insure that that eventuality does not come about?

Mr. SHANNON. Senator, as you know and the people of the Commonwealth know, we have been very actively involved over the last year in asserting, at every point we can, the rights of the people of the Commonwealth in protecting them against the Seabrook power plant. I want to say here tonight that I feel equally about the Pilgrim nuclear power plant. The Pilgrim nuclear power plant has the added disadvantage of a proven record of mismanagement on the part of the utility company which manages them, and I intend to fight just as hard to protect people around Pilgrim as we have around Seabrook.

[Applause.]

Mr. SHANNON. Senator, I would like to ask that the petition filed by Governor Dukakis and myself be included in the record.

[The petition referred to follows:]

UNITED STATES OF AMERICA
BEFORE THE NUCLEAR REGULATORY COMMISSION

PETITION OF MICHAEL S. DUKAKIS, GOVERNOR AND JAMES M. SHANNON, ATTORNEY GENERAL FOR THE INSTITUTION OF A PROCEEDING PURSUANT TO 10 C.F.R §2.202 TO MODIFY, SUSPEND, OR REVOKE THE OPERATING LICENSE HELD BY THE BOSTON EDISON COMPANY FOR THE PILGRIM NUCLEAR STATION

Dated: October 15, 1987

[illegible]

UNITED STATES OF AMERICA
BEFORE THE NUCLEAR REGULATORY COMMISSION

PETITION OF MICHAEL S. DUKAKIS, GOVERNOR AND
JAMES M. SHANNON, ATTORNEY GENERAL FOR THE
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10 C.F.R §2.202 TO MODIFY, SUSPEND, OR
REVOKE THE OPERATING LICENSE HELD BY
THE BOSTON EDISON COMPANY FOR THE
PILGRIM NUCLEAR STATION

I. INTRODUCTION

Governor Michael S. Dukakis and Attorney General James M. Shannon, pursuant to 10 C.F.R. §2.206, hereby request that the Director of the Office of Nuclear Reactor Regulation institute a proceeding pursuant to 10 C.F.R. §2.202 to modify, suspend, or revoke the operating license held by Boston Edison Company ("BECo." or "the Company") for the Pilgrim Nuclear Power Station ("Pilgrim") in Plymouth, Massachusetts. This petition is filed on behalf of the Commonwealth of Massachusetts and its citizens. The Governor and the Attorney General base this request on evidence of continuing serious managerial deficiencies at the plant, on evidence that a plant specific probabilistic risk assessment ("PRA") as well as the implementation of any safety modifications indicated thereby should be required prior to Pilgrim's restart, and on evidence that the state of emergency preparedness does not provide reasonable assurance that adequate protective measures can and

will be taken in the event of a radiological emergency during operations at the Pilgrim plant. The Governor and the Attorney General submit that this evidence, as set forth below, demonstrates the necessity of Nuclear Regulatory Commission ("NRC") action pursuant to 10 C.F.R. §2.202.

Further, the Governor and the Attorney General believe that the public interest requires that the NRC exercise its authority under 10 C.F.R. §2.202(f)[1/] so that BECo. is prevented from proceeding any further with the restart of Pilgrim[2/] until a formal adjudicatory hearing has been held and findings of fact are made concerning the safety questions surrounding the continued operation of the Pilgrim plant. In particular, the Governor and the Attorney General request that the NRC issue an order, effective immediately, modifying BECo's operating license to preclude BECo. from taking any steps in

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1/ 10 C.F.R. 2.02(f) provides:

> When the Executive Director for Operations, during an emergency as determined by the EDO, or the Director of Nuclear Reactor Regulation, Director of Nuclear Material Safety and Safeguards, Office of Inspections and Enforcement, as appropriate, finds that the public health, safety, or interest so requires or that the violation is willful, the order to show cause may provide, for stated reasons, that the proposed action be temporarily effective pending further review.

2/ At each step of BECo's so-called "power ascension" program there is an increase in the probability of an accident at Pilgrim as well as in the potential consequences of such an accident. See Affidavit of Steven C. Sholly (attached hereto as Attachment 1).

its power ascension program until the hearing is held and the findings are made.

II. EVIDENCE OF SERIOUS MANAGERIAL DEFICIENCIES

Recent events at Pilgrim indicate that BECo. has not corrected the long-standing managerial shortcomings that have plagued the plant. In the areas of security, radiological controls, personnel management, and corporate culture, the management of Pilgrim continues to be seriously flawed. As a result, Pilgrim poses an unreasonable risk to public health and safety. Its continued operation under the present circumstances is inimical to public health and safety.

A. OVERVIEW

Pilgrim commenced commercial operation in June, 1972, when BECo. received an operating license for the plant. During the intervening fifteen year period of operation by BECo., Pilgrim has had a capacity factor of approximately 50 percent,[3/] which compares quite unfavorably with the average for all New England nuclear plants of approximately 67 percent.[4/]

3/ The "capacity factor" for a plant is a measure of performance in terms of the power it has actually delivered over a period of time relative to the power it was capable of delivering over that same period of time. It is calculated by dividing the actual number of kilowatt hours produced by the plant in the period of measurement by the product of the plant's rated kilowatt capacity and the number of hours in the period.

4/ Electric Council of New England, New England Nuclear News, (June, 1987) (Attached hereto as Attachment 2).

B. BECo's PAST PERFORMANCE

The plant has been out of service since April, 1986, when the NRC, in Confirmatory Action Letter 86-10, ordered a shutdown after recurring operational problems at the plant.[5/]

Pilgrim has been beset with managerial problems from the outset. BECo. has consistently received low ratings in the NRC's Systematic Assessment of Licensee Performance ("SALP") reports. Pilgrim has been identified by the NRC as one of the worst run and least safe plants in the country[6/] and BECo. was ordered to initiate performance/management improvement programs in 1982 and 1984.[7/] BECo. has been the subject of a long line of enforcement actions as a result of regulatory violations. While the NRC's efforts to spur BECo. to a higher level of performance have, on occasion, met with some initial success, a review of BECo's performance record, however, shows that all such successes have been short lived. Indeed, BECo.

5/ Confirmatory Action Letter 86-10 was clarified and expanded in an subsequent letter, dated August 27, 1987, from the NRC Region 1, Regional Administrator to BECo's Chief Operating Officer. (attached hereto as Attachment 3). In this letter, BECo. was informed that:

> In light of the number and scope of the outstanding issues, I (the Regional Administrator) am not prepared to approve restart of the Pilgrim facility until you (BECo.) provide a written report that documents BECo's formal assessment of the readiness for restart operation.

6/ Boston Globe, May 28, 1986.

7/ Order Modifying License Effective Immediately, 47 Fed. Reg. 4171 (January 28, 1987).

appears to have an organic inability to manage Pilgrim in an effective and safe manner.8/

** BECo's SALP Evaluations **

BECo. has consistently received low ratings in SALP reports.9/

8/ Although it is the failings of BECo's management of the Pilgrim plant which are the subject of this petition, it is significant that findings have been made in other settings that confirm BECo's managerial deficiencies and indicate that they extend to the other aspects of its business. See e.g., Boston Edison Company, Massachusetts Department of Public Utilities Docket No. 87-1A-A (1987) (imprudence in operation of oil fired generating unit). Of particular relevance to the notion that BECo. responds to the identification of deficiencies with half-hearted (although sometimes quite showy), short-term solutions that treat the symptoms, not the disease, is the series of decisions by the Massachusetts Department of Public Utilities that address BECo's need to consider and develop new sources of power in the aftermath of the 1981 cancellation of the construction of the Pilgrim II nuclear unit. Boston Edison Company, MDPU 906 (1982) (ordering BECo. to develop a new plan to meet its future power needs); Boston Edison Company, MDPU No. 86-270 (found reason to believe BECo lacked commitment and/or skill to fulfill public service obligation).

9/ The SALP process is the mechanism by which the NRC on a periodic basis systematically assesses the overall performance of a licensee. For each assessment period (generally 12 to 18 months) a Board of NRC officials evaluates, in accordance with preestablished attributes and rating guidance, the licensee's performance for each of the various, preestablished functional areas and rates the licensee's performance in each area. The Board also compares the licensee's performance for the current period with that of the previous assessment period and identifies, for further followup and inspection, any areas where the licensee's corrective action to improve performance has not been fully effective.

Arizona Public Service Company, (Palo Verde Nuclear Generating Station, Unit 2), DD-86-8, 24 NRC 151, 156 (1986).

In 1980, BECo. received ratings indicating significant weakness in three of the nine functional areas evaluated. The most recent SALP Report, seven years later, indicates that conditions have not improved but rather have worsened. BECo. received ratings indicating significant weaknesses in five of the twelve functional areas evaluated. It has only once received a SALP Report without a rating indicating a significant weakness. On all other occasions, it has received reports indicating significant weaknesses in at least two functional areas. (See Appendix I: BECo. SALP History Tabulation)

Of particular significance, every time Quality Assurance has been assessed as a separate functional area during a SALP review, BECo. has received the lowest possible rating. These findings are indicative of the ineffectiveness of BECo's management. They are a measure of its inability and/or its lack of commitment to run the plant in a effective and safe manner.

Although BECo. has at one time or another received the lowest possible rating in all but three of the twelve functional areas covered by the NRC's SALP process, these individual poor SALP ratings are not the most troubling aspect of BECo's SALP record. Instead, the most troubling and telling facet of BECo's SALP record is the Company's distinct inability to maintain any period-to-period performance improvements. BECo. has at one time or another improved its SALP performance

in eight functional areas. However, it has not been able to sustain the increased level of performance in seven of those eight areas. In all but one instance, BECo's improved performance proved to be short-lived and its performance subsequently fell back to lower levels. This is not surprising as an ever recurring theme in NRC evaluations of BECo's performance is that NRC oversight and prompting is necessary at every stage of Pilgrim's operation.[10/] The increased NRC attention (i.e., oversight and prompting) that a "3" rating calls for has, on occasion, produced better performance by BECo. However, when that level of attention returns to that norm, BECo's performance falls below the norm. BECo's SALP track record is proof of the proposition that BECo. by itself has not effectively operated Pilgrim and that the short-term solutions it has adopted in response to criticism have invariably permitted the reoccurrence of the original problems.

** BECo's Regulatory Violations **

BECo., an enforcement action record that is a mirror of its SALP Report record. It has had at least one Severity Level III violation during each of the past six years.[11/] (See

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10/ E.g., 1987 SALP Review at 8; 1986 SALP Review at 7.

11/ As set forth in 10 C.F.R. Part 2, Appendix C; General Statementof Policy and Procedure for NRC Enforcement Actions, regulatory violations are categorized into five descending levels of severity. Level III corresponds with "violations that are cause for significant concern."

Appendix II: BECo. VIOLATIONS TABULATIONS - SEVERITY LEVEL III VIOLATIONS) In the area of Security and Safeguards, BECo. had a Severity Level III violation in all but one of the years between 1981 and 1986. In 1982, a civil penalty in the amount of $550,000 -- at the time the largest penalty to have ever been assessed by the NRC -- was levied against BECo. for serious plant operations violations and for submitting false information to the NRC.[12/] While the number of such Severity Level III violations discovered at Pilgrim has not exceeded two in any single year since 1981, the number of Severity Level IV violations per year has more than doubled in the past few years.

BECo's enforcement action record also mirrors its SALP Report record in demonstrating BECo's chronic recidivism. It has been cited five times for Radiological Controls violations involving waste shipment packaging requirements.[13/]

It has been cited five times for Security and Safeguards violations involving the control of sensitive material such as keys to vital areas, security plans, and firearms.[14/]

12/ U.S. General Accounting Office, Report to the Honorable Alfonse M. D'Amato, U.S. Senate: Nuclear Regulation Efforts to Ensure Nuclear Power Plant Safety Can Be Strengthened (GAO-RCED-87-141 August, 1987), pp. 36-37.

13/ See NRC Enforcement Summary Tables taken from various SALP Reports (attached hereto as Attachment 4).

14/ Id.

C. RECENT INDICIA OF BECo'S PERFORMANCE LEVEL

The most recent indicia of the level of BECo's performance in managing Pilgrim are consistent with its past performance. They confirm the notion that BECo. appears to be organically incapable of managing a nuclear facility. Notwithstanding the frequent incantation by senior management of a program for the "pursuit of excellence," the addition of new personnel and the expenditure of large sums of money,[15/] the available evidence indicates that BECo. has not changed. Its 1987 SALP Report shows that the Company continues to merit the lowest possible ratings in many functional areas. BECo. continues to be incapable of maintaining performance gains. On the basis of news reports, it appears that BECo's management of the Security and Safeguards function is deteriorating, not improving. Further, on the basis of statements made by NRC officials at a recent meeting, the NRC has received and is investigating allegations that the company may be compromising safety by overworking its or its contractors' employees in an effort to return the plant to service soon. This evidence suggests that BECo's claim to be approaching readiness for restart may

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15/ *E.g.*, NRC Docket No. 50-293, Official Transcript of NRC Office of Nuclear Reactor Regulation, "Meeting With Boston Edison Re: Pilgrim Status and Activities Leading to Restart Readiness," pp. 13-14, 18-20 (September 24, 1987) (hereinafter "9/24/87 NRC/BECo. Readiness Meeting"). (Testimony Submitted by Stephen J. Sweeney, President and Chief Executive Officer, Boston Edison Company, to the U.S. House of Representatives, Subcommittee on Energy Conversation and Power of the Committee on Energy and Commerce July 16, 1986, pp. 4-5 (attached hereto as "Attachment 5").

be hasty and misleading.[16/]

** BECo's 1987 SALP Report **

On April 8, 1987, the NRC released a SALP Report for BECo. which was based on the results of various inspections and evaluations conducted at Pilgrim over the period from November 1, 1985 through January 31, 1987. Ratings were given for BECo's performance in twelve functional areas. In keeping with its past record, BECo. received the lowest possible ratings in five of the twelve functional areas.[17/] It received the highest possible rating in only two functional areas.[18/] The picture painted in the SALP report is one of a plant with "(p)oor management control," an "obscured ... chain of command and weakened accountability," and "(s)significant recurring program weakness ... in some functional areas, showing the effect of ... long-term problems."[19/]

16/ BECo's claim of readiness should be measured against its adoption of 9/24/87 NRC/BECo. Readiness Meeting, p. 43. This tendency to ignore reality in the operation of the plant has been previously found to be undesirable. See Boston Edison Company, MDPU NO. 1009-F (1982) (BECo. denied where evidence established that it had imprudently underestimated the necessary time required to perform outage tasks).

17/ The five areas were: Radiological Controls, Surveillance, Fire Protection, Security and Safeguards, and Assurance of Quality.

18/ The two areas were: Outage Management, Modifications, and Technical Support Activities and Engineering and Corporate Technical Support.

19/ 1987 SALP REPORT at 8.

Of particular importance to this Petition, were SALP ratings in three areas where BECo. had previously improved its performance. In the functional areas of Surveillance, Fire Protection, and Licensing Activities, BECo. had in the past improved its ratings between periods -- in fire protection, it had gone from a "3" to a "1" between its third and fourth SALP Reports -- but by the time of the review for the 1987 SALP Report, its performance had fallen back to earlier levels.

With respect to the functional area of Security and Safeguards, the 1987 SALP Report discussed continuing hardware problems, BECo's excessive reliance upon contractors, and management's failure to give this area sufficient attention.[20/] The report noted that BECo's corrective actions for deficiencies in this area had not generally been effective and referenced three degradations in vital area barriers that had occurred during the evaluation period.[21/]

20/ *Id.* at 31-34.

21/ The Commission's regulations define a "vital area" as any area which contains:

> any equipment, system, device, or material, the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation. Equipment or systems which would be required to function to protect public health and safety following such failure, destruction, or release are also considered vital areas. 10 C.F.R. §73.2(h) and (i) (emphasis added). Such areas are to "be located within a protected area such that access to vital equipment requires passage through at least two physical barriers." 10 C.F.R. §73.50(b)(1). Access into a protected area is to be controlled through the checking of authorization and identity at entry control points to which barriers surrounding the protected area "channel persons and material." 10 C.F.R §73.45(b)(1)(i) and 73.50(c).

** Recent Reports of Violations **

On the basis of news reports and statements made by NRC officials at a recent meeting, it appears that BECo. has suffered from at least four significant Security and Safeguards lapses in the past six months: a misplaced gun; a misplaced set of sensitive keys; a "serious degradation in a vital area barrier;" and ineffective identification cards.[22/] While all four alleged lapses would be significant, the latter three would be a particularly strong indication of BECo's failure to learn from its past mistakes -- nearly identical lapses have occurred in the past.[23/]

Further, allegations have recently been made which NRC stated at a recent meeting that they are investigating that BECo. may be compromising worker and/or plant safety by requiring excessive overtime.[24/]

III. EVIDENCE THAT INDICATES THAT A PLANT SPECIFIC PRA FOLLOWED BY IMPLEMENTATION OF ANY INDICATED SAFETY MODIFICATIONS SHOULD BE REQUIRED TO PILGRIM'S RESTART.

Pilgrim is a GE Mark I design plant. As such, it has a primary containment which, by nearly unanimous agreement, has an extremely high probability of failure in the event of

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22/ Boston Globe, September 4, 1987, p. 1; Boston Globe, September 9, 1987, p. 21; Boston Herald, September 10, 1987, p. 24.

23/ *See* *1985 SALP Report*, p. 40; *1983 SALP Report*, pp. 41-43; *1982 SALP Report*, p. 38 (included in Attachment 3 hereto).

24/ Boston Globe, September 29, 1987, p. 21.

certain accidents.[25/] This characteristic is especially critical since Mark I design reactors, such as Pilgrim, do not have the backup of a secondary containment structure which can withstand any significant position pressure. ("PWRs").[26/] In fact, Pilgrim's so-called "containment building" is not really designed to perform a backup function. It has "blow panels" which in some design and most severe accidents would activate and create a ready path for hazardous radioactive materials to escape into the environment.[27/] The combination of an extremely vulnerable primary containment structure, a secondary containment not designed to provide an effective backup, and the large population in the immediate vicinity of Pilgrim[28/] compel the Governor and the Attorney General to request that the NRC modify the Pilgrim operating license to bar restart until a plant specific probabilistic risk assessment ("PRA") is performed for Pilgrim and all indicated safety modifications are implemented. Until this occurs, the operation of the plant would pose an unreasonable threat to public health and safety.[29/]

25/ *See* NUREG-1150, Reactor Risk Reference Document, Draft for Comment, Feb. 1987, at 4-33, 4-39.

26/ Affidavit of Steven C. Sholly (attached hereto as Attachment 1).

27/ *Id.*

28/ *Id.*

29/ *Id.*

The Governor and the Attorney General are aware that the NRC has to date declined to order mitigative modifications for Mark I design plants.[30/] They submit, however, that the evidence presented here -- the combination of extremely vulnerable containment structures and a large population surrounding the plant -- precludes application of NUREG-1150's finding that the probability of a large reactor accident with early fatalities is extremely remote. The NUREG-1150 findings do not reflect the amalgam of risks posed by Pilgrim.

BECo. has proposed a number of modifications as remedial actions for the plant's design deficiencies.[31/] These actions do not, however, address the inherent defects of the plant's design in any real way. The Governor and the Attorney General do, however, submit that through its so-called "safety enhancement program," BECo. has put the question of the appropriate modifications to be made to remedy the defects of the Mark I design in issue.

30/ E.g., Boston Edison Company (Pilgrim Nuclear Station), DD-87-14, __ NRC __ (1987) (slip at 31-32).

31/ Letter with enclosures dated July 8, 1987, from Mr. Ralph G. Bird, Senior Vice President-Nuclear, Boston Edison Company, to Mr. Steven A. Varga, Director, Division of Reactor Projects, I/II, Nuclear Regulatory Commission (attached hereto as Attachment 6).

IV. EVIDENCE OF INADEQUATE EMERGENCY PREPAREDNESS

Within the past twelve months, two authoritative assessments have been made of the Pilgrim Radiological Emergency Response Plan and the state of emergency preparedness within the Emergency Planning Zone ("EPZ") for Pilgrim.[32/] Both conclude that the plan and the state of preparedness "are not adequate to protect the health and safety of the public in the event of an accident at the Pilgrim Nuclear Power Station."[33/] Both also concluded that the plan and the state of preparedness have significant deficiencies and suggest potential remedies for those deficiencies that will require a substantial commitment of time, resources and cooperation.[34/] BECo. has not quarreled with these conclusions.[35/] The Governor and the Attorney General submit that these conclusions compel immediate action by the NRC. The

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32/ FEMA, "Self-Initiated Review and Interim Finding for the Pilgrim Nuclear Power Station, Plymouth, MA" (August 4, 1987) (hereinafter "FEMA Self-Initiated Review"); Secretary of Public Safety, "Report to the Governor on Emergency Preparedness for an Accident at the Pilgrim Nuclear Power Station" (December 16, 1986) (hereinafter "Barry Report").

33/ FEMA Self-Initiated Review at 1-2; Barry Report at 74.

34/ FEMA Self-Initiated Review, pp. 12-13, 19, 22, 29-32, 43-44; Barry Report, pp. 47-55.

35/ 9/24/87 NRC/BECo Readiness Meeting", pp. 49-54.

authoritative expert agencies[36] agree that there is no reasonable assurance that the public can or will be protected in the event of an accident at Pilgrim. It is, thus, incumbent upon the NRC to take action immediately to insure that no steps are taken by BECo. which could increase the likelihood or the consequences of an accident.[37]

A. THE PLANNING AND PREPAREDNESS DEFICIENCIES IDENTIFIED BY FEMA AND THE MASSACHUSETTS EXECUTIVE OFFICE OF PUBLIC SAFETY

The deficiencies of the Radiological Emergency Response Plans for Pilgrim are manifold. Although the analyses of FEMA and the Massachusetts Executive Office of Public Safety do not reach the same conclusions on all issues, the following areas of substantial deficiency have been identified by both agencies:

1. the lack of any articulated evacuation plans for public and private schools as well as day care centers;

2. the lack of any articulated evacuation plans for the special needs population;

36/ FEMA is explicitly recognized by the Commission as the expert Federal authority on questions of nuclear power plant offsite emergency preparedness (Memorandum of Understanding, 50 Fed. Reg., No. 75, 15,486 (April 18, 1985) and the Commission is expressly required to base its findings on off-site emergency issues on FEMA's conclusions concerning such issues. 10 C.F.R. §50.47(s)(3). The Massachusetts Secretary of Public Safety oversees the Massachusetts Civil Defense Agency and Office of Emergency Planning, which pursuant to M.G.L. c. 147, §1 is responsible for the Commonwealth's emergency activities.

37/ Each step of BECo's power ascension plan corresponds with a substantial increase in the probability of an accident at Pilgrim. Affidavit of Steven C. Sholly (attached hereto as Attachment 1).

3. the lack of any articulated evacuation plans for the transport dependent population;

4. the lack of identifiable public shelters for the beach population;

5. the lack of a reception center, as required in the plan, for people evacuating by the northern route;

6. the lack of real progress in planning and the diminution in the state of emergency preparedness.38/

These are critical deficiencies. The plans do not even purport to provide any measure of protection for significant numbers of people: pre-school and school age children; those who require special measures to transport; and those without ready access to private transportation. They fail to address the significant beach population in an adequate fashion. They do not incorporate current or reliable evacuation time estimates ("ETEs"). Nor do they incorporate a delineated inventory of identified and identifiable shelters which are accessible to the public. Moreover an integral component of the current plans -- a northern reception center39/

38/ FEMA Self-Initiative Review, pp. 12-13, 19, 22, 29-32, 43-44; Barry Report, pp. 47-55.

39/ The lack of a reception center for those evacuating to the north is as worrisome as the more general planning failures. The lack of a northern reception center indicates that even if evacuation from the EPZ were successful -- a heroic assumption in light of the assorted planning deficiencies -- those who received and followed instructions to evacuate to the north would find no facilities available at their designated destination. According to FEMA, approximately 60,000 people would be left without facilities at which to register, be monitored and decontaminated if necessary. FEMA Self-Initiated Review at 19.

-- is missing altogether. Finally, offsite exercises and drills -- the most effective means of assuring preparedness -- have not been held in years.

B. THE CURRENT STATUS OF PLANNING AND PREPAREDNESS

The specific functional deficiencies in the first four areas enumerated above, as well as the functional areas in which work must be done before any determination can be made if adequate plans can be developed, encompass the entire set of tasks required for adequate planning and preparedness:

1. Identification/Estimation of populations;
2. Identification/Estimation of resources;
3. Develop plans for emergency actions to be taken for each population with potentially available resources;
4. Obtain commitments for required resources;
5. Provide education/information to public;
6. Conduct exercises/drills.

At present, it appears that the school/daycare population has been identified but that the special needs and transport dependent populations have not.40/ Preliminary estimates of the resources potentially available to evacuate these populations have now been obtained, but neither plan development nor obtaining commitments of resource availability can proceed in the absence of reliable ETEs.41/

40/ Executive Summary of the Report on Emergency Preparedness For an Accident at Pilgrim Power Station) (October 15, 1987) (hereinafter "Barry Report Update"), p. 2.

41/ Id. at 2.

While BECo. has recently -- August 18, 1987 -- delivered an ETE study to the Commonwealth's public safety officials,[42] the document is still being reviewed by those officials and preliminary analysis has uncovered shortcomings that will necessitate further work. It is, thus, unlikely that final ETEs will be available within the immediate future for use in developing specific plans.[43] This shortcoming is critical. A consequence of the unavailability of reliable ETEs is that emergency planning is effectively on hold. Even when the task of identifying/estimating populations and resources is completed, radiological emergency planning cannot in any real sense proceed without reliable ETEs and a traffic management plan. As FEMA and the NRC well recognize, a realistic set of ETEs is an essential element of a workable emergency plan. See Cincinnatti Gas & Electric Company (Wm. H. Zimmer Nuclear Power Station, Unit No. 1), ALAB-727, 17 NRC 760, 770-71 (1983).

With respect to the beach population, preliminary population estimates and sheltering data have been provided to the Commonwealth's public safety officials but, at least in the case of the sheltering survey, these materials have been found

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42/ KLD Associates, Pilgrim Station Evacuation Time Estimates and Traffic Management Plan Update (Final Draft for Review) August 18, 1987.

43/ Barry Report Update, p. 2.

to be inadequate for planning purposes.[44/]

Again, plan development and resource availability commitments, much less public education/information efforts and exercises/drills, cannot proceed usefully without reliable final ETEs and sheltering data.[45/]

No replacement site for a northern reception center has been found[46/] and no determination has yet been made whether an emergency plan incorporating only two reception centers would provide an adequate assurance of protection.[47/]

44/ Barry Report Update, p. 2; Letter with enclosures from Robert J. Boulay, Director, Massachusetts Civil Defense Agency, dated September 18, 1987, to Ralph C. Bird, Executive Vice President-Nuclear, Boston Edison Company (attached hereto as Attachment 7)

45/ Barry Report Update, p. 2; See also FEMA Self-Initiated Review at 26-27:

> Before FEMA and the RAC can make a determination on this (whether protective actions for thebeach population are or readily can be made adequate) it must receive the following information:
>
> 1) an updated geographical description of the beaches and their capacity; 2) a detailed analysis of the beach population, including the number of permanent and temporary residents and the number of day visitors, together with their geographical dispersion; 3) an updated estimate of the length of time it would take to evacuate the beach population; and 4) a list of suitable buildings available for sheltering the beach population at each beach, including the capacities of these buildings and their distances from the beaches. If these buildings are not open to the public, the plans must clearly state how they will be made accessible and letters of agreement must be obtained as appropriate.

46/ Id.

47/ 9/24 NRC/BECo. Readiness Meeting, p. 52. But see FEMA Self-Initiated Review at 19 (The use of only two reception centers "is not likely to be logistically feasible.").

Finally, in the absence of new plans, public information/education efforts and exercises/drills cannot, by definition, occur. There are no plans to inform the public of exercises, much less to exercise. Although the provisions of 10 C.F.R. Part 50, Appendix E, Section IV.F. require that a full participation biennial emergency preparedness exercise for Pilgrim be held this year, the NRC is presently considering a request from BECo. for a one-time exemption from that requirement to allow the exercise to be postponed to the second quarter of 1988.[43/]

IV. CONCLUSION

In light of all of the foregoing deficiencies of the current state of emergency planning and preparedness, as well as the substantial questions raised herein concerning the managerial ability of the licensee, BECo., and the safety of the Pilgrim reactor, the Governor and Attorney General submit that the NRC must take action pursuant to 10 C.F.R. §2.202 to insure that BECo. does not take any action that could increase either the risk or the consequences of an accident at Pilgrim.

Since that Pilgrim is a GE Mark I design reactor, and the EPZ population at this plant is among the highest in the country, it is evident that the deficiencies in emergency planning and preparedness are significant for Pilgrim. These

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43/ Letter with enclosures dated September 18, 1987, from Mr. Ralph G. Bird, Senior Vice President-Nuclear, Boston Edison Company, to NRC (attached hereto as Attachment 8).

deficiencies are so substantial and their potential ramifications are so significant, that it is impossible to conclude that any interim compensating actions have or can be taken. The NRC's regulations leave it no course other than issuing an order modifying BECo's license to extend the current shut down pending the outcome of a full hearing on the significant outstanding safety issue and the development and certification by the Governor of adequate emergency plans.49/

Respectively submitted,

James M. Shannon
Attorney General
Commonwealth of Massachusetts

Michael S. Dukakis
Governor
Commonwealth of Massachusetts

Dated: October 15, 1987

49/ Compare 10 C.F.R. §50.54(s)(2)(ii):

> ... In determining whether a shutdown or other enforcement action is appropriate, the Commission shall take into account, among other factors, whether the licensee can demonstrate to the Commission's satisfaction that the deficiencies in the plan are not significant for the plant in question, or that adequate interim compensating actions have been or will be taken promptly, or that there are other compelling reasons for continued operation.

APPENDIX I: BECo. SALP HISTORY TABULATION

Inspec. Period	Plant Oper.	Radiol. Control	Maint.	Surveil.	Fire Prot.	Emergen. Prepare
01/01/80 12/31/80	2	3	2	2	2	2
09/01/80 08/31/81	3	2	3	2	2	1
09/01/81 06/30/82	3	2	2	2	3	1
07/01/82 06/30/83	2	2	2	1	1	1
07/01/83 09/30/84	2	3	1	1	2	3
10/01/84 10/31/85	3	3	2	2	-	3
11/01/85 01/31/87	2	3	2	3	3	2

Inspec. Period	Secur. Safegds	Out.Mgt. Mod.Act	Licen. Activ.	Eng/Corp Tech.Sup	Train Qual.Ef	Quality Assuran
01/01/80 12/31/80	2	3	-	-	-	3
09/01/80 08/31/81	2	2	-	-	-	3
09/01/81 06/30/82	2	2	2	-	-	-
07/01/82 06/30/83	2	-	1	-	-	-
07/01/83 09/30/84	2	1	1	-	-	-
10/01/84 10/31/85	2	1	1	-	-	-
11/01/85 01/31/87	3	1	2	1	2	3

APPENDIX II: BECo. VIOLATIONS TABULATIONS

SEVERITY LEVEL III VIOLATIONS: 9/1/81-1/31/87

Functional Area	1981	1982	1983	1984	1985	1986	1987
Plant Operations	3						
Radiological Controls	1			2		1	
Mainenance							
Surveillance							
Fire Protection							
Emergency Preparedness		1					
Security/Safeguards	1	1	1		1		?
Outage Mgt ...							
Licensing Activities							
Training ... Eff'ness							
Assurance of Quality							
Engineer/Corp. Support							

BECo. VIOLATIONS BY SEVERITY LEVEL: 9/1/81-1/31/87

Severity Level	81/82	82/83	83/84	84/85	85/87
I					
II					
III	7	1	1	2	1
IV	9	9	18	17	21
V	20	20	6	5	6
VI	2				
Deviations	2	3	1	3	1
Total Violations	40	33	26	27	29

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE COMMISSION

In the matter of	)	
	)	
BOSTON EDISON COMPANY	)	Docket No. 50-293
	)	
(Pilgrim Nuclear Power Station, Unit 1)	)	

AFFIDAVIT OF STEVEN C. SHOLLY

Steven C. Sholly, being on oath, deposes and says as follows:

1. I am an Associate Consultant with MHB Technical Associates, 1723 Hamilton Avenue, Suite K, San Jose, California, 95125. A statement of my professional qualifications is attached hereto and marked Attachment A. In brief, I have more than six years experience in the review, analysis, interpretation, and application of probabilistic risk assessment to the analysis of safety issues related to commercial nuclear power plants, including issues related to radiological emergency planning. I have served as a member of the peer review group for the NRC publication NUREG-1050 (1984) (Probabilistic Risk Assessment (PRA) Reference Document, September 1984), and have more recently served as a member of the *Containment Performance Design Objective Workshop*, the *Panel on ACRS Effectiveness* (1985), and the *Severe Accident Policy Implementation External Events Workshop* (1987). I have previously testified as an expert witness on probabilistic risk assessment and emergency planning matters in NRC proceedings on the Catawba Units 1 and 2, Indian Point Units 2 and 3, and Shoreham Unit 1 nuclear plants, and also in the Public Inquiry regarding the proposed Sizewell-B nuclear plant in the United Kingdom. In addition, I have co-authored two major reviews of source term

and risk estimate issues published in NRC reports NUREG-0956 and NUREG-1150. I have also performed reviews of various technical aspects of the Shoreham, Limerick, Indian Point, Sizewell, Zion, Seabrook, Millstone-3, and Oconee-3 probabilistic risk assessments and the Vermont Yankee Containment Safety Study.

2. MHB Technical Associates ("MHB") has been requested by the Nuclear Safety Division, Department of the Attorney General, The Commonwealth of Massachusetts, to evaluate the increase in risk resulting from a startup program for return to power from the current refueling and modifications outage for the Pilgrim Nuclear Power Station, Unit 1 (PNPS-1).

3. In its current configuration (refueled) and considering the duration of the current shutdown, Pilgrim currently poses very little risk to the public health and safety. This is due to the multiplicity of systems theoretically available to inject water into the reactor vessel and due to the low decay heat level present in the fuel. In the event of a core heatup transient with the plant in its current configuration, considerable time would elapse between initiation of coolant loss and the onset of fuel damage, time during which measures could be taken to initiate coolant makeup and/or other recovery and mitigative actions. Moreover, in theory a longer time period is available within which to implement offsite protective actions due to the slower accident progression time compared with accidents at higher power levels.

4. Boston Edison Company (BECO), the licensee for Pilgrim, currently envisions restart power ascension program with a minimal number of hold points. In brief, BECO proposes to institute holds on restart (pending approval from NRC in accord with Confirmatory Action Letter No. 86-10), recovery from reactor mode switch testing prior to conducting a test for shutdown from outside the control room, and prior to movement of the scram set point above 95% power. [*See*, Boston Edison Company, *Pilgrim Nuclear Power Station Restart Plan*, pages IV-29 to IV-31.] The details of the power ascension program in Attachment 13 of the *Pilgrim Nuclear Power Station Restart Plan* have not yet been provided.

5. My current understanding of the BECO power ascension program is that the program would result in a relatively rapid ascension from the current shutdown condition to full-power operation. In so doing, the risk to the public health and safety posed by operations at the Pilgrim plant will be increased markedly.

6. The Commission has concluded generally that the risks from 5% power operation are negligible. [*See*, for example, SECY-84-155, 12 April 1984, and attachments; and letter dated 15 June 1984 from Nunzio J. Palladino to Hon. Edward J. Markey, and attachments.] The evaluations upon which the Commission has drawn these conclusions, however, were for plants with very little operating history and no spent fuel pool inventory. Clearly, Pilgrim is different in this regard, with a substantial long-half-life fission product inventory present in both the refueled reactor core and the spent fuel pool. Moreover, these evaluations did not consider the unique risks posed by accidents resulting from externally-initiated events (specifically, in this case, seismic events). In my opinion, the presence of more than 1100 spent fuel assemblies, prior operation of two-thirds of the core at equivalent full power for most of an operating cycle, and the matter of external events render the circumstances at Pilgrim sufficiently different from those previously evaluated for 5% power operation that the previous evaluations understate, perhaps significantly, the risk posed by operation of Pilgrim at 5% of full power. This conclusion is further supported by the likelihood that the primary containment will not be inerted until operation above 5% power is commenced. In my opinion, virtually any severe accident at 5% power with the containment de-inerted will result in early containment failure (due to hydrogen burn or hydrogen detonation in the primary containment, and/or other causes).

7. As power level increases, risk to the public increases. This is due to several factors, including a marked increase in volatile fission product inventory and a marked increase in decay heat level, which results in accident progression times which are much shorter than at low power levels. This reduces the amount of time available for implementation of recovery and/or mitigation

actions and reduces the amount of time available to implement offsite protective measures.

8. A full-scope probabilistic risk assessment for the Pilgrim plant has been in progress for several years. It is my understanding that this study is nearly completed. It is my expectation that this study will identify seismic initiating events as a significant contributor to core melt frequency (i.e., contributing 10% or more to core melt frequency from all causes). This expectation is based on my familiarity with seismic risk assessments performed on similar designs and performed on other plants in the general region of Pilgrim (e.g., Shoreham, Seabrook Units 1 and 2, Millstone Unit 3, and Limerick Units 1 and 2). Seismically-initiated accident sequences are accompanied by potentially severe impacts on offsite emergency response even when there are fully-approved and operational emergency plans. In the case of Pilgrim, the current status of emergency planning is such that there is not adequate assurance that protective actions can and will be taken in the event of an accident. Given the more severe conditions of a seismically-initiated accident scenario, this conclusion is all the more applicable.

9. A study of risk at 25% power for the Shoreham nuclear plant, which possesses a nuclear steam supply system which is grossly similar to Pilgrim, indicates that the core melt frequency for operations at up to 25% of full power may not differ dramatically from the core melt frequency at full power. The 25% power PRA estimates a core melt frequency of 2.8×10^{-5} per reactor-year. [See, E.T. Burns, S. Mays, and T. Mairs, *Probabilistic Risk Assessment of the Shoreham Nuclear Power Station: Initial Power Operation Limited to 25% of Full Power*, Delian Corporation, prepared for Long Island Lighting Company, April 1987, page 4-12.] The full power PRA analyses for Shoreham estimated a core melt frequency of about 6.5×10^{-5} per reactor-year. [See, Science Applications, Inc., *Final Report: Probabilistic Risk Assessment, Shoreham Nuclear Power Station*, prepared for Long Island Lighting Company, 24 June 1983, page 4; and V. Joksimovich, et al., *Major Common-Cause Initiating Events Study: Shoreham Nuclear Power Station*, NUS Corporation, NUS Report No. NUS-4617, prepared for Long Island Lighting Company, February 1985, page 1-8]

This represents less than a factor of three difference in the likelihood of a core melt accident at 25% power versus full power. Although this assessment is for Shoreham and not for Pilgrim, it suggests that the likelihood of an accident is not markedly different for 25% power versus 100% power.

10. Further, a limited-scope PRA of Shoreham at 5% power was prepared for LILCO. This study, which did not include external events, concluded that the core melt frequency for 5% power operation was about 4.9 x 10^{-6} per reactor-year. [*See*, Delian Corporation and Science Applications, Inc., *Probabilistic Risk Assessment, Shoreham Nuclear Power Station, Low Power Operation Up to 5% of Full Power*, prepared for Long Island Lighting Company, draft, May 1984, page 78.] This indicates that core melt frequency at 5% power is significantly reduced from 25% power or full power, by a factor of roughly 20, but not nearly as significantly reduced as previously predicted by the NRC staff, which predicted a reduction factor of 1,000 or more. 1/ Moreover, the 5% power reduction factor of 20 is an underestimate since the 5% power estimates do not include external events.

11. The 5%, 25%, and 100% power PRA studies for Shoreham indicate, in my opinion, that the core power level for Pilgrim will have at best a moderate impact on the likelihood of an accident. Considering the uncertainties involved, the likelihood of an accident may be nearly indistinguishable at the various power levels indicated above. Moreover, the Shoreham results are lower than the core melt frequency estimates for many other plants. A Brookhaven National Laboratory review of the Shoreham PRA for internal events only estimated a core melt frequency of 1 x 10^{-4} per reactor-year. An average value for full-scope PRAs completed to date is of the order of 3 x 10^{-4} per reactor-year.

1/ The NRC staff, in SECY-84-156, predicted core melt frequency reduction factors for various classes of BWR accidents ranging from 1,000 to 100,000. [*See*, SECY-84-156, Enclosure 1, "*Staff Review Process for 5 Percent Power Operation*", page 2.] Thus, in the aggregate, the NRC staff would have expected a core melt frequency reduction of *at least* 1,000, compared with the Shoreham value of 20. The results for Shoreham indicate a reduction factor approximately 50 times less than the NRC staff expected based on engineering judgment.

12. These results are especially significant for a plant with a containment design similar to Pilgrim. Pilgrim employs a steel Mark I pressure suppression containment. Such containments have been estimated in a variety of studies sponsored by IDCOR, NRC, and utilities to have an early containment failure probability -- given a severe accident -- in a range from 10-90%. This means that there is a significant chance that, given a severe accident, the accident will be accompanied by a large early release of radioactivity to the environment.

13. The Pilgrim plant, like all Mark I containment design plants, also employs a secondary containment, usually referred to as a reactor building. This structure is not designed to withstand the high internal pressures which would accompany a severe accident, and is unlikely to survive in a leak-tight condition following primary containment failure. High pressure in the secondary containment due to a severe accident would be produced by a combination of blowdown due to primary containment failure, primary containment leakage, primary containment venting, and burning of combustible gases. Indeed, Mark I plants are designed with both internal and external "blow-out panels" which are *designed* to relieve pressure. In the case of Pilgrim, there are blow-out panels at the refueling deck elevation which relieve pressure directly to the environment. In my opinion, there is little basis for assuming that releases from the primary containment will be significantly mitigated by the presence of the secondary containment.

13. Based on the above considerations, it is my opinion that Pilgrim Unit 1 should not be restarted until the offsite emergency response plans are upgraded and evaluated to adequately protect the public health and safety. Further, it is my recommendation that BECO be required to promptly submit the Pilgrim probabilistic risk assessment study to the NRC for public review and evaluation prior to restart. The review of such a study should indicate whether there

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remain significant operational risks which must be ameliorated in order to provide adequate protection to the public health and safety.

Steven C. Sholly
Steven C. Sholly
Associate Consultant

GENERAL ACKNOWLEDGMENT

State of California
County of Santa Clara } SS

On this the 14th day of October, 19 87 before me Myrna L. Barry the undersigned Notary Public, personally appeared Steven C. Sholly

personally known to me
✓ proved to me on the basis of satisfactory evidence
to be the person(s) whose name(s) is subscribed to the within instrument and acknowledged that he executed it.
WITNESS my hand and official seal.

OFFICIAL SEAL
MYRNA L BARRY
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My comm. expires JUN 24, 1991

Notary's Signature Myrna L. Barry

ATTACHMENT A

PROFESSIONAL QUALIFICATIONS OF STEVEN C. SHOLLY

STEVEN C. SHOLLY
MHB Technical Associates
1723 Hamilton Avenue
Suite K
San Jose, California 95125
(408) 266-2716

EXPERIENCE:

September 1985 - PRESENT

Associate - MHB Technical Associates, San Jose, California

Associate in energy consulting firm that specializes in technical and economic assessments of energy production facilities, especially nuclear, for local, state, and federal governments and private organizations. MHB is extensively involved in regulatory proceedings and the preparation of studies and reports. Conduct research, write reports, participate in discovery process in regulatory proceedings, develop testimony and other documents for regulatory proceedings, and respond to client inquiries. Clients have included: State of California, State of New York, State of Illinois.

February 1981 - September 1985

Technical Research Associate and Risk Analyst - Union of Concerned Scientists, Washington, D.C.

Research associate and risk analyst for public interest group based in Cambridge, Massachusetts, that specializes in examining the impact of advanced technologies on society, principally in the areas of arms control and energy. Technical work focused on nuclear power plant safety, with emphasis on probabilistic risk assessment, radiological emergency planning and preparedness, and generic safety issues. Conducted research, prepared reports and studies, participated in administrative proceedings before the U.S. Nuclear Regulatory Commission, developed testimony, anlayzed NRC rule-making proposals and draft reports and prepared comments thereon, and responded to inquiries from sponsors, the general public, and the media. Participated as a member of the Panel on ACRS Effectiveness (1985), the Panel on Regulatory Uses of Probabilistic Risk Assessment (Peer Review of NUREG-1050; 1984), Invited Observer to NRC Peer Review meetings on the source term reassessment (BMI-2104; 1983-1984), and the Independent Advi-sory Committee on Nuclear Risk for the Nuclear Risk Task Force of the National Association of Insurance Commissioners (1984).

January 1980 - January 1981

Project Director and Research Coordinator - Three Mile Island Public Interest Resource Center, Harrisburg, Pennsylvania

Provided administrative direction and coordinated research projects for a public interest group based in Harrisburg, Pennsylvania, centered around issues related to the Three Mile Island Nuclear Power Plant. Prepared fundraising proposals, tracked progress of U.S. Nuclear Regulatory Commission, U.S. Department of Energy, and General Public Utilities activities concerning cleanup of Three Mile Island Unit 2 and preparation for restart of Three Mile Island Unit 1, and monitored developments related to emergency planning, the financial health of General Public Utilities, and NRC rulemaking actions related to Three Mile Island.

July 1978 - January 1980

Chief Biological Process Operator - Wastewater Treatment Plant, Derry Township Municipal Authority, Hershey, Pennsylvania

Chief Biological Process Operator at a 2.5 million gallon per day tertiary, activated sludge, wastewater treatment plant. Responsible for biological process monitoring and control, including analysis of physical, chemical, and biological test results, procees fluid and mass flow management, micro-biological analysis of activiated sludge, and maintenance of detailed process logs for input into state and federal reports on treatment process and effluent quality. Received certification from the Commonwealth of Pennsylvania as a wastewater treatment plant operator. Member of Water Pollution Control Association of Pennsylvania, Central Section, 1980.

July 1977 - July 1978

Wastewater Treatment Plant Operator - Borough of Lemoyne, Lemoyne, Pennsylvania

Wastewater treatment plant operator at 2.0 million gallon per day secondary, activated sludge, wastewater treatment plant. Performed tasks as assigned by supervisors, including simple physical and chemical tests on wastewater streams, maintenance and operation of plant equipment, and maintenance of the collection system.

September 1976 - June 1977

Science Teacher - West Shore School District, Camp Hill, Pennsylvania

Taught Earth and Space Science at ninth grade level. Developed and implemented new course materials on plate tectonics, environmental geology, and space science. Served as Assistant Coach of the district gymnastics team.

September 1975 - June 1976

Science Teacher - Carlisle Area School District, Carlisle, Pennsylvania

Taught Earth and Space Science and Environmental Science at ninth grade level. Developed and implemented new course materials on plate tectonics, environmental geology, noise pollution, water pollution, and energy. Served as Advisor to the Science Projects Club.

EDUCATION:

B.S., Education, majors in Earth and Space Science and General Science, minor in Environmental Education, Shippensburg State College, Shippensburg, Pennsylvania, 1975.

Graduate coursework in Land Use Planning, Shippensburg State College, Shippensburg, Pennsylvania, 1977-1978.

PUBLICATIONS:

1. "Determining Mercalli Intensities from Newspaper Reports," Journal of Geological Education, Vol. 25, 1977.

2. A Critique of: An Independent Assessment of Evacuation Times for Three Mile Island Nuclear Power Plant, Three Mile Island Public Interest Resource Center, Harrisburg, Pennsylvania, January 1981.

3. A Brief Review and Critique of the Rockland County Radiological Emergency Preparedness Plan, Union of Concerned Scientists, prepared for Rockland County Emergency Planning Personnel and the Chairman of the County Legislature, Washington, D.C., August 17, 1981.

4. The Necessity for a Prompt Public Alerting Capability in the Plume Exposure Pathway EPZ at Nuclear Power Plant Sites, Union of Concerned Scientists, Critical Mass Energy Project, Nuclear Information and Resource Service, Environmental Action, and New York Public Interest Research Group, Washington, D.C., August 27, 1981. *

5. "Union of Concerned Scientists, Inc., Comments on Notice of Proposed Rulemaking, Amendment to 10 CFR 50, Appendix E, Section IV.D.3," Union of Concerned Scientists, Washington, D.C., October 21, 1981. *

6. "The Evolution of Emergency Planning Rules," in The Indian Point Book: A Briefing on the Safety Investigation of the Indian Point Nuclear Power Plants, Anne Witte, editor, Union of Concerned Scientists (Washington, D.C.) and New York Public Interest Research Group (New York, NY), 1982.

7. "Union of Concerned Scientists Comments, Proposed Rule, 10 CFR Part 50, Emergency Planning and Preparedness: Exercises, Clarification of Regulations, 46 F.R. 61134," Union of Concerned Scientists, Washington, D.C., January 15, 1982. *

8. Testimony of Robert D. Pollard and Steven C. Sholly before the Subcommittee on Energy and the Environment, Committee on Interior and Insular Affairs, U.S. House of Representatives, Middletown, Pennsylvania, March 29, 1982, available from the Union of Concerned Scientists.

9. "Union of Concerned Scientists Detailed Comments on Petition for Rulemaking by Citizen's Task Force, Emergency Planning, 10 CFR Parts 50 and 70, Docket No. PRM-50-31, 47 F.R. 12639," Union of Concerned Scientists, Washington, D.C., May 24, 1982.

10. Supplements to the Testimony of Ellyn R. Weiss, Esq., General Counsel, Union of Concerned Scientists, before the Subcommittee on Energy Conservation and Power, Committee on Energy and Commerce, U.S. House of Representatives, Union of Concerned Scientists, Washington, D.C., August 16, 1982.

11. Testimony of Steven C. Sholly, Union of Concerned Scientists, Washington, D.C., on behalf of the New York Public Interest Research Group, Inc., before the Special Committee on Nuclear Power Safety of the Assembly of the State of New York, hearings on Legislative Oversight of the Emergency Radiologic Preparedness Act, Chapter 708, Laws of 1981, September 2, 1982.

12. "Comments on 'Draft Supplement to Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant'," Docket No. 50-537, Union of Concerned Scientists, Washington, D.C., September 13, 1982. *

13. "Union of Concerned Scientists Comments on 'Report to the County Commissioners', by the Advisory Committee on Radiological Emergency Plan for Columbia County, Pennsylvania," Union of Concerned Scientists, Washington, D.C., September 15, 1982.

14. "Radiological Emergency Planning for Nuclear Reactor Accidents," presented to Kernenergie Ontmanteld Congress, Rotterdam, The Netherlands, Union of Concerned Scientists, Washington, D.C., October 8, 1982.

15. "Nuclear Reactor Accident Consequences: Implications for Radiological Emergency Planning," presented to the Citizen's Advisory Committee to Review Rockland County's Own Nuclear Evacuation and Preparedness Plan and General Disaster Preparedness Plan, Union of Concerned Scientists, Washington, D.C., November 19, 1982.

16. Testimony of Steven C. Sholly before the Subcommittee on Oversight and Investigations, Committee on Interior and Insular Affairs, U.S. House of Representatives, Washington, D.C., Union of Concerned Scientists, December 13, 1982.

17. Testimony of Gordon R. Thompson and Steven C. Sholly on Commission Question Two, Contentions 2.1(a) and 2.1(d), Union of Concerned Scientists and New York Public Interest Research Group, before the U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board, in the Matter of Consolidated Edison Company of New York (Indian Point Unit 2) and the Power Authority of the State of New York (Indian Point Unit 3), Docket Nos. 50-247-SP and 50-286-SP, December 28, 1982. *

18. Testimony of Steven C. Sholly on the Consequences of Accidents at Indian Point (Commission Question One and Board Question 1.1, Union of Concerned Scientists and New York Public Interest Research Group, before the U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board, in the Matter of Consolidated Edison Company of New York (Indian Point Unit 2) and the Power Authority of the State of New York (Indian Point Unit 3), Docket Nos. 50-247-SP and 50-286-SP, February 7, 1983, as corrected February 16, 1983. *

19. Testimony of Steven C. Sholly on Commission Question Five, Union of Concerned Scientists and New York Public Interest Research Group, before the U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board, in the Matter of Consolidated Edison Company of New York (Indian Point Unit 2) and the Power Authority of the State of New York (Indian Point Unit 3), Docket Nos. 50-247-SP and 50-286-SP, March 22, 1983. *

20. "Nuclear Reactor Accidents and Accident Consequences: Planning for the Worst," Union of Concerned Scientists, Washington, D.C., presented at Critical Mass '83, March 26, 1983.

21. Testimony of Steven C. Sholly on Emergency Planning and Preparedness at Commercial Nuclear Power Plants, Union of Concerned Scientists, Washington, D.C., before the Subcommittee on Nuclear Regulation, Committee on Environment and Public Works, U.S. Senate, April 15, 1983, (with "Union of Concerned Scientists' Response to Questions for the Record from Senator Alan K. Simpson," Steven C. Sholly and Michael E. Faden).

22. "PRA: What Can it Really Tell Us About Public Risk from Nuclear Accidents?," Union of Concerned Scientists, Washington, D.C., presentation to the 14th Annual Meeting, Seacoast Anti-Pollution League, May 4, 1983.

23. "Probabilistic Risk Assessment: The Impact of Uncertainties on Radiological Emergency Planning and Preparedness Considerations," Union of Concerned Scientists, Washington, D.C., June 28, 1983.

24. "Response to GAO Questions on NRC's Use of PRA," Union of Concerned Scientists, Washington, D.C., October 6, 1983, attachment to letter dated October 6, 1983, from Steven C. Sholly to John E. Bagnulo (GAO, Washington, D.C.).

25. The Impact of "External Events" on Radiological Emergency Response Planning Considerations, Union of Concerned Scientists, Washington, D.C., December 22, 1983, attachment to letter dated December 22, 1983, from Steven C. Sholly to NRC Commissioner James K. Asselstine.

26. Sizewell 'B' Public Inquiry, Proof of Evidence on: Safety and Waste Management Implications of the Sizewell PWR, Gordon Thompson, with supporting evidence by Steven Sholly, on behalf of the Town and Country Planning Association, February 1984, including Annex G, "A review of Probabilistic Risk Analysis and its Application to the Sizewell PWR," Steven Sholly and Gordon Thompson, (August 11, 1983), and Annex O, "Emergency Planning in the UK and the US: A Comparison," Steven Sholly and Gordon Thompson (October 24, 1983).

27. Testimony of Steven C. Sholly on Emergency Planning Contention Number Eleven, Union of Concerned Scientists, Washington, D.C., on behalf of the Palmetto Alliance and the Carolina Environmental Study Group, before the U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board, in the Matter of Duke Power Company, et. al. (Catawba Nuclear Station, Units 1 and 2), Docket Nos. 50-413 and 50-414, April 16, 1984. *

28. "Risk Indicators Relevant to Assessing Nuclear Accident Liability Premiums," in Preliminary Report to the Independent Advisory Committee to the NAIC Nuclear Risk Task Force, December 11, 1984, Steven C. Sholly, Union of Concerned Scientists, Washington, D.C.

29. "Union of Concerned Scientists' and Nuclear Information and Resource Service's Joint Comments on NRC's Proposal to Bar from Licensing Proceedings the Consideration of Earthquake Effects on Emergency Planning," Union of Concerned Scientists and Nuclear Information and Resource Service, Washington, D.C., Diane Curran and Ellyn R. Weiss (with input from Steven C. Sholly), February 28, 1985. *

30. "Severe Accident Source Terms: A Presentation to the Commissioners on the Status of a Review of the NRC's Source Term Reassessment Study by the Union of Concerned Scientists," Union of Concerned Scientists, Washington, D.C., April 3, 1985. *

31. "Severe Accident Source Terms for Light Water Nuclear Power Plants: A Presentation to the Illinois Department of Nuclear Safety on the Status of a Review of the NRC's Source Term Reassessment Study (STRS) by the Union of Concerned Scientists," Union of Concerned Scientists, Washington, D.C., May 13, 1985.

32. The Source Term Debate: A Review of the Current Basis for Predicting Severe Accident Source Terms with Special Emphasis on the NRC Source Term Reassessment Program (NUREG-0956), Union of Concerned Scientists, Cambridge, Massachusetts, Steven C. Sholly and Gordon Thompson, January 1986.

33. Direct Testimony of Dale G. Bridenbaugh, Gregory C. Minor, Lynn K. Price, and Steven C. Sholly on behalf of State of Connecticut Department of Public Utility Control, Prosecutorial Division and Division of Consumer Counsel, regarding the prudence of expenditures on Millstone Unit III, February 18, 1986.

34. Implications of the Chernobyl-4 Accident for Nuclear Emergency Planning for the State of New York, prepared for the State of New York Consumer Protection Board, by MHB Technical Associates, June 1986.

35. Review of Vermont Yankee Containment Safety Study and Analysis of Containment Venting Issues for the Vermont Yankee Nuclear Power Plant, prepared for New England Coalition on Nuclear Pollution, Inc., December 16, 1986.

36. Affidavit of Steven C. Sholly before the Atomic Safety and Licensing Board, in the matter of Public Service Company of New Hampshire, et al., regarding Seabrook Station Units 1 and 2 Off-site Emergency Planning Issues, Docket Nos. 50-443-OL & 50-444-OL, January 23, 1987.

37. Direct Testimony of Richard B. Hubbard and Steven C. Sholly on behalf of California Public Utilities Commission, regarding Diablo Canyon Rate Case, PG&E's Failure to Establish Its Committed Design QA Program, Application Nos. 84-06-014 and 85-08-025, Exhibit No. 10,935, March, 1987.

38. Testimony of Gregory C. Minor, Steven C. Sholly et. al. on behalf of Suffolk County, regarding LILCO's Reception Centers (Planning Basis), before the Atomic Safety and Licensing Board, in the matter of Long Island Lighting Company, Shoreham Nuclear Power Station Unit 1, Docket No. 50-322-OL-3, April 13, 1987.

39. Rebuttal Testimony of Gregory C. Minor and Steven C. Sholly on behalf of Suffolk County regarding LILCO's Reception Centers (Addressing Testimony of Lewis G. Hulman), Docket No. 50-322-OL-3, May 27, 1987.

40. Review of Selected Aspects of NUREG-1150, "Reactor Risk Reference Document," prepared for the Illinois Department of Nuclear Safety by MHB Technical Associates, September 1987.

* Available from the U.S. Nuclear Regulatory Commission, Public Document Room, Lobby, 1717 H Street, N.W., Washington, D.C.

NEW ENGLAND NUCLEAR NEWS

NUCLEAR GENERATION AS A PERCENT OF TOTAL ENERGY REQUIREMENTS

APRIL, 1987

Plant	Net Kilowatthours	Barrels Oil Saved	CAPACITY FACTORS Month %	Year to Date %	Cumulative %
Connecticut Yankee	334,216,000	554,300	80.0	92.0	76 0
Millstone 1	463,479,000	768,600	97.7	97.0	68 4
Millstone 2	597,711,000	991,200	94.9	81 1	62 5
Millstone 3	453,732,000	752,500	54.7	68.7	78 9
Vermont Yankee	353,972,000	587,000	95.8	99 1	68 7
Maine Yankee	-0-	-0-	-0-	64 1	68.9
Yankee	97,011,000	160,900	*77.1	88.5	70.9
Pilgrim	-0-	-0-	-0-	-0-	52.9
*coastdown					
Weighted Average Capacity Factor			58.6%	71.1%	67.0%

Total Nuclear Generation	2,300,121,000
Total Energy Requirements	8,184,000,000
Nuclear as % of Total	28 1%
Total Barrels Oil Saved	3,814,500

TWELVE MONTHS ENDED APRIL 1987:

Nuclear Generation:	32,699,000,000 kwhs
Nuclear as a Percent of Total Energy Requirements:	32.0 percent
Barrels of Oil Saved:	54,227,000 barrels

New England Nuclear News

ELECTRIC COUNCIL OF NEW ENGLAND
54 MIDDLESEX TURNPIKE, BEDFORD, MA 01730

New England Nuclear News

JUNE 1987
(April Data)

CONNECTICUT YANKEE

On April 16, the plant shutdown because of problems with turbine control valve #4. After chemistry holds and a load runback, the plant reached full power (94%) on April 21st. The Institute for Nuclear Power Operations (INPO) will conduct its annual critique of plant operations beginning on June 8th.

MAINE YANKEE

Maine Yankee shutdown for refueling is proceeding generally according to schedule with startup expected in early June. Very small cracks found in the disks of both low pressure turbine rotors have necessitated the replacement of one and the repair of the other.

YANKEE

Yankee began its 18th refueling on May 2nd. The last cycle of the plant produced more than 2 million megawatthours over a 17 month period with a capacity factor of 93 percent.

PILGRIM

Pilgrim remained off-line during the month.

VERMONT YANKEE

On April 4, Vermont Yankee came down in power and took the turbine off-line to repair a small steam leak in a main steam drain line. The plant came back on-line the same day and operated at full power for the remainder of the month.

MILLSTONE 1 & 2

Millstone Unit 1 operated routinely for the month of April. A scheduled refueling outage will begin in mid-June and last for approximately 10 weeks. Millstone Unit 2 operated routinely except for a trip on April 16 due to a generator exciter field circuit breaker opening on presumed bistable transformer fault indication. Instruments in place to monitor the suspect bistable. The unit returned to service after a 20 hour outage on April 18.

MILLSTONE 3

Millstone Unit 3 returned to service after a scheduled outage. After startup on April 11, the unit tripped on the next day while at 10 percent power level due to steam generator low level when turbine driven feed pump oscillated. Feedwater regulating control valve failed to open on demand due to a control air leak. The unit returned to service on April 14 after being out for 29 hours.

ecne

Published by the
Nuclear Information Committee
of the Electric Council
of New England

NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

AUG 27 1986

Docket No. 50-293

Boston Edison Company M/C Nuclear
ATTN: Mr. James M. Lydon
Chief Operating Officer
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Confirmatory Action Letter 86-10

This letter is to provide further guidance on the requirements we expect to be met prior to the restart of the Pilgrim plant. We acknowledge receipt of Boston Edison Company's (BECO) letter of June 16, 1986, in response to Confirmatory Action Letter (CAL) 86-10. Your actions with regard to the issues in CAL 86-10 appear to be thorough and technically sound. My staff has a few remaining questions, which have been discussed with your staff and which will be documented in Inspection Report 50-293/86-25.

In addition to the specific plant hardware issues involved with CAL 86-10, several other issues have been identified that require resolution prior to restart of the Pilgrim plant. Specific technical issues of concern include: overdue surveillances, malfunction of recirculation motor generator set field breakers, seismic qualification of emergency diesel generator differential relays, and completion of Appendix R modifications. Please be prepared to discuss these issues at our next management meeting at the plant on September 9, 1986. We would also like to hear at this meeting the scope and status of all your programs related to restart of Pilgrim. These include (a) the results of your six week action plan for improvements, (b) the role of BECO safety review committees, including the Program For Excellence Task Force, in assessing readiness for restart, and (c) the readiness of the plant and corporate staff to support plant startup, testing, and operations.

In light of the number and scope of the outstanding issues, I am not prepared to approve restart of the Pilgrim facility until you provide a written report that documents BECO's formal assessment of the readiness for restart operation. This assessment should include your detailed check list for assuring that all outstanding items have been satisfactorily resolved and that plant systems have been restored and prepared for operation. A formal restart program and schedule should also be submitted for NRC review and approval. This program should include hold points at appropriate stages such as criticality, completion of mode switch testing, and at specific milestones during ascension to full power. Authorization to proceed beyond each hold point will be contingent upon my approval and will be based on my staff's evaluation of the operational performance of the plant. We will have substantially augmented NRC inspection coverage during this restart period.

Please plan to submit your readiness assessment and restart program and schedule at least forty-five days before your planned startup from the current outage. My decision on restart will be based in part on our review of these documents.

Your cooperation is appreciated.

Sincerely,

Thomas E. Murley

Thomas E. Murley
Regional Administrator

cc:
L. Oxsen, Vice President, Nuclear Operations
A. E. Pedersen, Station Manager
Paul Levy, Chairman, Department of Public Utilities
Edward R. MacCormack, Senior Regulatory Affairs and Program Engineer
Chairman, Board of Selectmen
Plymouth Civil Defense Director
The Honorable E. J. Markey
J. D. Keyes
Senator Edward P. Kirby
The Honorable Peter V. Forman
Sharon Pollard
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
NRC Resident Inspector
Commonwealth of Massachusetts (2)

UNITED STATES NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

APR 08 1987

Docket No. 50-293

Boston Edison Company M/C Nuclear
ATTN: Mr. Ralph Bird
Senior Vice President - Nuclear
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Systematic Assessment of Licensee Performance (SALP) Report No. 50-293/86-99

The Region I SALP Board has reviewed and evaluated the performance of activities at the Pilgrim Nuclear Power Station for the period November 1, 1985 through January 31, 1987. The results are presented in the enclosed report. A meeting to discuss this assessment will be scheduled for a mutually acceptable date. The meeting will be held on or near the site so that appropriate senior corporate management and plant officials can discuss with us the strengths and weaknesses noted. It is our intent that this meeting be combined with the periodic management meeting to review improvement program status.

The SALP Board identified significant recurring program weaknesses in some functional areas. Improvements, such as in the area of emergency preparedness, were also noted. However, the SALP Board found the rate of such change was slow during most of the assessment period.

We recognize that the Boston Edison Company (BECo) has made significant staffing and hardware commitments to improve performance at the Pilgrim Station and we believe they are beginning to have a positive impact. As you are aware, the NRC is looking for progress in correcting the previously identified long term problems at the Pilgrim Station prior to plant restart, particularly in those functional areas with a Category 3 rating.

In preparation for the SALP meeting, please be prepared to discuss your evaluation of our assessment and the status of your performance improvement programs. Any comments you may have regarding our report may be discussed at the meeting. Additionally, you may provide written comments within 30 days after the meeting. Following our meeting and receipt of your written response, the enclosed report, your response, and a summary of our findings and planned actions will be placed in the NRC Public Document Room.

TABLE 4

ENFORCEMENT SUMMARY (11/01/85 - 01/31/87)

PILGRIM NUCLEAR POWER STATION

A. Number and Severity Level of Violations

Severity Level I	0
Severity Level II	0
Severity Level III	1
Severity Level IV	21
Severity Level V	6
Deviation	1
Total	29

B. Violations Vs. Functional Area

		Severity Levels						
	Functional Areas	I	II	III	IV	V	Dev	Total
1	Plant Operations	-	-	-	-	1	-	1
2	Radiological Controls	-	-	1	3	-	-	4
3	Maintenance	-	-	-	1	-	-	1
4	Surveillance	-	-	-	6	3	-	9
5	Fire Protection	-	-	-	5	-	1	6
6	Emergency Preparedness	-	-	-	-	-	-	0
7	Security Safeguards	-	-	-	1	1	-	2
8	Outage Management and Modification Activities	-	-	-	1	1	-	2
9	Licensing Activities	-	-	-	-	-	-	0
10	Training and Qualification Effectiveness	-	-	-	-	-	-	0
11	Assurance of Quality	-	-	-	4	-	-	4
12	Engineering and Corporate Technical Support	-	-	-	-	-	-	-
	Totals	0	0	1	21	6	1	29

TABLE 4 (Continued)

C Summary

Inspection Report Number	Severity Level	Functional Area	Violation
85-32	V	Surveillance	Instrument channel tests were not being performed monthly for the reactor building vent and stack waste gas monitors.
85-32	V	Security Safeguards	Failure to perform a proper search of a package brought into the protected area.
86-01	V	Plant Operations	Post trip review 86-01 and 86-02 lacked required recorder charts. Inadequate control room log entries on disabled annunciators.
86-04	III	Radiological Controls	A waste shipment of solid metallic oxides on non-compacted trash lacked required strong packaging and quality control measures
86-06	IV	Surveillance	Replacement squib charges were installed in the standby liquid control system from a batch that had not been tested during a manual initiation of the Standby Liquid Control System.
86-10	IV	Radiological Controls	Radiation surveys of packaged irradiated reactor components were not documented on appropriate radiation survey forms and maps.
86-11	IV	Assurance of Quality	Quality control measures were not taken in transferring radioactive waste shipments

TABLE 4 (Continued)

C Summary

Inspection Report Number	Severity Level	Functional Area	Violation
86-14	IV	Assurance of Quality	Previously identified inadequacies involving surveillance testing of the high pressure coolant injection system were not corrected for six months
86-14	V	Surveillance	Failure to properly control measuring and test equipment
86-21	IV	Surveillance	Battery rated load discharge Test procedure was not updated to reflect system alterations and restorations
86-25	IV	Assurance of Quality	Failure and Malfunction Report was not completed by engineering personnel after they identified deficient station fire barriers.
86-25	[illegible]	Surveillance	Surveillance tests were performed without independent verification of system response and system restoration.
86-25	Deviation	Fire Protection	Failure to comply with the commitment to conduct quarterly fire brigade drills for all fire brigade members
86-34	IV	Security Safeguards	Improper package search and inadequate follow up.
86-36	IV	Fire Protection	Fire brigade members had not received the required training.
86-36	IV	Fire Protection	Fire watches failed to perform the required hourly patrol of the motor generator set room

TABLE 4 (Continued)

C. Summary

Inspection Report Number	Severity Level	Functional Area	Violation
86-37	IV	Fire Protection	Inadequate fire brigade drill.
86-37	IV	Modifications	Safety-related modifications were not performed in accordance with applicable design requirements.
86-38	IV	Fire Protection	Adequate procedures and drawings had not been established for the station fire water system.
86-44	IV	Radiological Controls	Failure to implement a radiological control procedure for checking vehicles leaving the site.
87-01	IV	Surveillance	Failure to adhere to the procedure governing surveillance testing of the Post Accident Sampling System (PASS) system.
87-01	IV	Maintenance	Lack of procedure guidance on maintenance of the heat tracing control circuit relays for the PASS system.
87-03	IV	Fire Protection	Failure to take required action for inoperable fire protection equipment.
87-03	IV	Radiological Controls	Failure to control a master key to all locked high radiation areas.
87-03	IV	Assurance of Quality	Failure and Malfunction Report not completed after a safety-related bus transfer did not occur during a surveillance test.

TABLE 4 (Continued)

C Summary

Inspection Report Number	Severity Level	Functional Area	Violation
87-04	IV	Surveillance	A surveillance test on Standby Gas Treatment System failed to meet the intent of the Tech Spec requirements.
87-04	IV	Surveillance	Failure to calibrate measuring and test equipment.
87-04	V	Modification	Performing post-modification test on the refuel bridge without approved procedure changes.
87-04	IV	Surveillance	Master test program procedures do not adequately address surveillance test and post modification test programs.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA PENNSYLVANIA 19406

MAY 2 3 1986

RECEIVED
MAY 30
E. P. D

Docket No. 50-293

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Systematic Assessment of Licensee Performance (SALP)
Report No. 50-293/85-99

This letter refers to the Systematic Assessment of Licensee Performance (SALP) of the Pilgrim Nuclear Power Station for the period of October 1, 1984 through October 31, 1985, initially forwarded to you by our February 18, 1986 letter (Enclosure 1). This SALP evaluation was discussed with you and your staff at a meeting held in Plymouth, Massachusetts on March 5, 1986 (see Enclosure 2 for attendees). We have reviewed your March 26, 1986 written comments (Enclosure 3) and herewith transmit the final report (Enclosure 4).

Overall, your performance in the operation of the facility was found acceptable although some areas were only minimally acceptable.

As projected in our letter of February 18, 1986, a special in-depth team inspection was conducted from February 18 to March 7, 1986 (Inspection Report No. 50-293/86-06) to determine the underlying reasons for the poor performance discussed above. The team found that improvements were inhibited by (1) incomplete staffing, in particular operators and key mid-level supervisory personnel, (2) a prevailing view in the organization that the improvements made to date have corrected the problems, (3) reluctance, by management, to acknowledge some problems identified by the NRC, and (4) dependence on third parties to identify problems rather than implementing an effective program for self-identification of weaknesses. We believe these findings confirmed the SALP Board conclusions.

We acknowledge your discussion of program and staffing improvements in plant operations, radiological controls and emergency preparedness. However, we believe that the success of your programs depends upon resolution of the four principal factors inhibiting improvement noted above which, in turn, depends heavily on management attitudes and aggressive followup. In this regard we request that you be prepared to discuss the scope, content and schedule of each improvement program at a management meeting scheduled for 1:00 p.m. on June 12, 1986 at the NRC Region I Office.

TABLE 4

ENFORCEMENT SUMMARY (10/1/84 - 10/31/85)

PILGRIM NUCLEAR POWER STATION

FUNCTIONAL AREAS		Severity Levels I	II	III	IV	V	DEV	Total
A.	Plant Operations	-	-	-	4	2	-	6
B.	Radiological Controls	-	-	1	1	1	2	5
C.	Maintenance & Modifications	-	-	-	1	-	-	1
D	Surveillance	-	-	-	9	2	1	12
E.	Emergency Preparedness	-	-	-	2	-	-	2
F.	Security & Safeguards	-	-	1	-	-	-	1
G.	Refueling & Outage Management	-	-	-	-	-	-	0
H	Licensing Activities	-	-	-	-	-	-	0
	Totals by Severity Level	0	0	2	17	5	3	27

TABLE 5

ENFORCEMENT DATA

PILGRIM NUCLEAR POWER STATION

Insp. No.	Insp. Date	Severity Level	Functional Area	Violation
84-36	11/1-11/85	IV	Plant Operations	Failure to conduct an adequate shift turnover for control room personnel during refueling
		IV	Plant Operations	Failure to continuously monitor source range monitors during refueling
84-39	11/21-12/31/84	IV	Surveillance	Failure to promptly identify conditions adverse to quality (i.e. failure to initiate Failure and Malfunction Reports)
84-41	12/10-13/84	IV	Emergency Preparedness	Failure to diseminate emergency planning information
		IV	Emergency Preparedness	Failure to update the emergency plan and procedures
84-44	12/18-19/84	III	Radiological Controls	Failure to follow radiation work permit instructions and failure to establish a procedure for a remote reading teledosimetry system
85-01	1/1-31/85	V	Plant Operations	Failure to maintain control room staffing at levels required by 10 CFR 50.54
		IV	Surveillance	Failure to test the containment cooling subsystem immediately when the low pressure coolant injection system was inoperable
85-03	2/1/85-3/4/85	IV	Surveillance	Failure to conduct surveillance tests for the reactor protection system (six examples)
		IV	Surveillance	Failure to conduct rod block surveillance tests (five examples)

Insp. No.	Insp. Date	Severity Level	Functional Area	Violation
		IV	Plant Operations	Failure to promptly correct conditions adverse to quality (i.e. failure to take timely action on Quality Assurance surveillance findings)
		V	Surveillance	Failure to use the most current revision of a surveillance test procedure
		V	Surveillance	Failure to calibrate test equipment within the calibrated period
85-06	3/5/85-4/1/85	V	Plant Operations	Failure to maintain an uncalibrated local power range monitor in a bypassed state
		IV	Maintenance	Failure to conduct a dioctyl phthalate test of HEPA filters following maintenance on the standby gas treatment system
85-13	5/20-24/85	V	Radiological Controls	Failure to have the Operations Review Committee (ORC) review two radiological procedures and failure to control work in the fuel pool with a maintenance request
		Deviation	Radiological Controls	Failure to conduct an adequate review of systems that could generate an uncontrolled, unmonitored radioactive effluent release, as recommended in IE Bulletin 80-10
85-17	6/13/85-7/15/85	IV	Surveillance	Failure to conduct a surveillance surveillance test of the 250 V battery system required by the technical specification and to follow station procedures for additional battery tests
		IV	Radiological Controls	Failure to specify high radiation area surveillance frequencies on radiation work permits

T-5-3

Insp No.	Insp Date	Severity Level	Functional Area	Violation
		Deviation	Surveillance	Failure to conduct inservice tests as specified in an NRC submittal
85-20	7/16/85-8/19/85	IV	Surveillance	Failure to maintain the trip level setting for the "B" and "C" main steam line high radiation monitors within technical specification limits
85-21	7/16/85-7/30/85	IV	Surveillance	Failure to maintain secondary containment
		IV	Surveillance	Failure to test alternate safety system when an emergency diesel generator was found to be inoperable
		IV	Surveillance	Failure to initiate Failure and Malfunction Reports as required by station procedures
85-24	8/6-8/85	III	Security	Failure to maintain an adequate vital area barrier
85-26	8/[illegible]/85-9/23/85	IV	Plant Operations	Failure to properly authorize excessive licensed operator overtime as required by station procedures (thirty-five instances)
85-27	9/16/85-9/20/85	Deviation	Radiological Controls	Failure to install a protective conduit

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA PENNSYLVANIA 19406

Docket No. 50-293

JUN 1 9 1985

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Systematic Assessment of Licensee Performance (SALP) Report No 50-293 84-34 and Your Reply Letter BECo 85-031 Dated February 12, 1985

Thank you for your reply to SALP Report No. 50-293/84-34. In your letter you presented additional information concerning assessments and requested we reconsider some of the assessments to better account for the assessment period's extraordinary circumstances (i.e., the extended outage for piping replacement).

Based on our discussions with you at the January 23, 1985 management meeting and the information presented in your reply letter, the SALP Board found it appropriate to revise the declining trend of the Category 2 rating for fire protection/housekeeping to a Category 2 rating with a consistent trend. We feel this is appropriate as we may not have properly accounted for the extended outage in our evaluation for trend. However, we continue to feel that the extent of contamination that existed throughout the plant was inconsistent with a Category 1 rating. The enclosed SALP Report has been supplemented to reflect this change. The SALP Board also found that the other ratings should remain unchanged.

With regard to the current status of your operations, we acknowledge the improving trend of your performance in the plant operations and maintenance areas and encourage you to continue your efforts in these areas. Further, we note the progress being made in implementing your recently established Radiological Improvement Program and encourage your efforts to decontaminate the plant, to reduce plant radiation levels, to enhance oversight of the radiation protection program, and to establish support for the program by plant personnel.

Your cooperation with us is appreciated.

Sincerely,

TEMurley

Thomas E. Murley
Regional Administrator

TABLE 2

VIOLATION SUMMARY (7/1/83 - 9/30/84)

PILGRIM NUCLEAR POWER STATION

A. Number and Severity Level of Violations

Severity Level I	0
Severity Level II	0
Severity Level III	1
Severity Level IV	18
Severity Level V	6
Deviation	1
Total	26*

B. Violations Vs. Functional Area

Functional Areas	Severity Level I	II	III	IV	V	DEV
A. Plant Operations				2	5	
B. Radiological Controls*			1	7	1	1
C. Maintenance				2		
D. Surveillance				1		
E. Fire Protection and Housekeeping						
F. Emergency Preparedness						
G. Security and Safeguards				6		
H. Refueling and Outage Management						
I. Licensing Activities						
Totals*			1	18	6	1

*Totals do not include three apparent violations and one apparent deviation in the area of radiological controls that were identified during inspection 84-25. NRC enforcement action was under review at the end of the assessment period.

C. Summary

Inspection Report No.	Inspection Date	Severity Level	Functional Area	Violation
83-19	8/16-10/3/83	V	A	Failure to review and up-date special orders
		V	A	Failure to vent piping from the high point in the core spray system
83-20	8/8-12/83	IV	B	Failure to follow a Radi-ation Work Permit
83-21	8/22-24/83	V	A	Failure to schedule exter-nal audits
		V	A	Failure to document defi-ciencies in deficiency reports
83-23	10/4-11/7/83	IV	D	Failure to conduct an in-service test on a high pressure coolant injection (HPCI) valve
		IV	C	Failure to review a proce-dure for procuring safety-related items.
83-24	11/8-12/31/83	IV	A	Failure to record reactor vessel cool down rate
84-03	1/20-27/84	III	B	Failure to label a container of licensed material, use extremity dosimetry, and instruct workers on radi-ation levels
84-04	2/7-3/12/84	IV	A	Failure to maintain a pro-cedure for the proper operation of the contain-ment atmospheric dilution system
84-06	2/13-17/84	IV	B	Failure to follow a radi-ation work permit

Inspection Report No.	Inspection Date	Severity Level	Functional Area	Violation
84-11	4/23-27/84	IV	C	Failure to maintain a procedure for controlling welding slag
84-13	4/24-27/84	IV	B	Failure to properly review and approve contractor procedures involving transportation of radioactive materials
		IV	B	Failure to comply with the requirements of a Certificate of Compliance for a transport package
		V	B	Failure to properly document a quality assurance program for transport packages
		DEV	B	Failure to fulfill a transportation training commitment
84-14	5/9-11/84	IV	B	Failure to instruct workers on the presence of radioactive materials
		IV	B	Failure to survey radiation hazards
		IV	B	Failure to implement procedures consistent with 10 CFR 20
84-22	7/16-20/84	IV	G	Failure to control a security key card
		IV	G	Failure to maintain photo ID badges
		IV	G	Failure to respond to two vital area alarms
		IV	G	Failure to maintain one guard radio and one offsite communications net operable

Inspection Report No.	Inspection Date	Severity Level	Functional Area	Violation
		IV	G	Failure to maintain effec-tive compensatory measures.
		IV	G	Failure to maintain effec-tive compensatory measures.
84-25	8/6-10/84	*	B	Failure to perform radiation surveys
		*	B	Failure to instruct workers on radiation hazards
		*	B	Failure to properly approve procedures
		*	B	Failure to implement recom-mendations in Regulatory Guide 8.8
84-26	8/28-10/8/84	V	A	Failure to properly approve QA program related proce-dures

*Apparent violations and deviations. Enforcement action was under review at the end of the assessment period.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

SEP 14 1983

Docket No. 50-293

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
800 Boylston Street
Boston, Massachusetts 02199

RECEIVED
SEP 15 1983
W. D. H.

Gentlemen:

SUBJECT: SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE (SALP)

The NRC Region I SALP Board conducted a review on August 25, 1983, and evaluated the performance of activities associated with the Pilgrim Nuclear Power Station. The results of this assessment are documented in the enclosed SALP Board Report. A meeting has been scheduled for September 21, 1983, at Braintree, Ma. to discuss this assessment.

At the meeting, you should be prepared to discuss our assessment and your plans to improve performance. Any comments you may have regarding our report may be discussed at the meeting. Additionally, you may provide written comments within 30 days after the meeting.

Following our meeting and receipt of your response, the enclosed report, your response, and a summary of our findings and planned actions will be placed in the NRC Public Document Room.

Your cooperation is appreciated.

Sincerely,

for H B Kister
Richard W. Starostecki
SALP Board Chairman, Director
Division of Project and
Resident Programs

Enclosure: As Stated

cc w/encl:
A. V. Morisi, Manager, Nuclear Operations Support
C. J. Mathis, Station Manager

TABLE 4

VIOLATIONS (7/1/82 - 6/30/83)

PILGRIM NUCLEAR POWER STATION

A. Number and Severity Level of Violations

Severity Level I	0
Severity Level II	0
Severity Level III	1
Severity Level IV	9
Severity Level V	20
Deviations	3
Total Violations	30

Total Deviations 3

B. Violations Vs. Functional Area

	Severity Levels					
FUNCTIONAL AREAS	I	II	III	IV	V	DEV
1. Plant Operations				4	8	
2. Radiological Controls				1	7	1
3. Maintenance				1		1
4. Surveillance						
5. Fire Protection/Housekeeping					3	1
6. Emergency Preparedness						
7. Security and Safeguards			1	3	2	
8. Refueling						
9. Licensing Activities						
Totals	0	0	1	9	20	3

Total Violations = 30

Total Deviations = 3

TABLE 4 (Continued)

Summary

Inspection No.	Inspection Date	Subject	Requirements	Severity	Area
82-19	June 14 - August 1	Blocking open a fire door without proper controls	T.S.	V	5
		Failure to evaluate fire loading prior to moving combustibles into safety related area	T.S.	V	5
		Failure to translate design bases into drawings	10CFR50 App. B	V	1
		Failure to perform an adequate safety evaluation prior to changing a station valve lineup procedure	10CFR50.59	V	1
		Failure to maintain a fire door position continuously annunciated	T.S.	V	5
		Failure to perform daily checks of non-alarmed fire doors as committed to the NRC	Fire Protection Review	D	5
82-22	August 2 -	Failure to make a prompt notification	T.S.	IV	1
		Failure to make a 50.72 notification	10CFR50	V	1
		Failure to perform a leak rate test required by the LCO for an inoperable Vacuum Breaker Alarm System	T.S.	IV	1

TABLE 4 (Continued)

Summary

Inspection No	Inspection Date	Subject	Requirements	Severity	Area
82-24	September 7 - October 18	Failure to revise procedures for radioactive discharges as committed to the NRC	Licensee Response to Violation 81-19-01	[illegible]	1
82-29	October 19 - November 15	Improper equipment tagging	T.S	V	1
		Failure to properly set a main steam safety valve			
		Failure to properly control distribution of the Q-List	10CFR50 App. B	IV	1
		Failure to use proper methods of access control	Security Plan	V	7
		Failure to prevent unauthorized entry into vital area or followup on a security deficiency	Security Plan	IV	7
N/A(1)	January 31, 1983	Safeguards information not properly controlled resulting in a loss of copy of the site physical Security Plan	10CFR73.21	III	7
83-03	January 25 February 28	Failure to perform chemistry samples	T.S.	V	2(1)*
		Failure to assure that training certification forms were completed prior to watch assignment	10CFR50 App. B	V	1
		Failure to properly control high pressure gas cylinders	T.S.	V	1(5)*

TABLE 4 (Continued)

Summary

Inspection No.	Inspection Date	Subject	Requirements	Severity	Area
83-07	March 22-April 18	Failure to implement a station procedure for inspection and cleaning of the SBGT System inlet plenum	T.S.	V	2,3,7
83-08	May 9 - May 13	Failure to conduct an audit of the Radiological Environmental Monitoring Program report when required	T.S.	V	2
83-09	April 4 - May 3	Accepting, in receipt inspection, material not in conformance with the P.O. Requirements	10CFR50 App. B	V	1
		Failure to maintain the Q-List	10CFR50 App. B	IV	1
	(2)	Failure to update the FSAR	10CFR50.71(e)	V	1
		Failure to perform preventive maintenance as committed to the NRC	IEB 79-09 Commitment	D	3
83-10	April 19 - May 23	Safeguards information not properly controlled	10CFR73.21	IV	7
		Security access card key not properly controlled	Security Plan	IV	7

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA PENNSYLVANIA 19406

NOV 1 5 1982

Docket No. 50-293

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Systematic Assessment of Licensee Performance (SALP)

This letter and its enclosures document NRC's assessment of the performance of licensed activities at the Pilgrim Nuclear Power Station for the period September 1, 1981, to June 30, 1982. The enclosed SALP Report, dated August 12, 1982, includes performance assessments for each of the nine functional areas which were evaluated. These individual assessments were discussed with you and your staff by Mr. R. W. Starostecki of this office on September 1, 1982, at the Boston Edison Company offices in Braintree, MA.

Our overall assessment of the performance of NRC licensed activities at the Pilgrim facility is that improvement has occurred since the organizational and personnel changes which took place earlier this year. There now appears to be a satisfactory level of management attention and involvement in plant safety matters. This has enhanced the plant's performance with respect to operational safety. We recognize that efforts are underway to improve the management systems and utilization of resources at the Pilgrim facility. These changes and plans are documented in the Performance Improvement Plan which were submitted to the NRC on July 30, 1982. However, we also realize that it will be several months before some of these improvements will be completed. Although performance has improved recently, some shortcomings have been noted and we have included them in this report. In particular, we believe additional attention is warranted on your part in the areas of day-to-day plant operations and fire protection/prevention activities. We will be increasing our attention to these areas to ascertain if identified weaknesses are being corrected.

In the meeting of September 1, 1982, the NRC staff benefited from your comments concerning the SALP Program and the functional area performance assessments. I have also reviewed your letter of September 20, 1982 and have included responses to your comments in this package. The SALP Board also considered your concerns and I had the benefit of their input. The results of these considerations are presented below.

TABLE 5

VIOLATIONS (9/1/81 - 6/30/82)

PILGRIM NUCLEAR POWER STATION

A. Number and Severity Level of Violations

a. Interim NRC Policy Severity Level (September 1, 1981 - March 9, 1982)

Severity Level I	0
Severity Level II	0
Severity Level III	6
Severity Level IV	5
Severity Level V	17
Severity Level VI	2
Deviation	1

b. NRC Policy Severity Levels (March 10, 1982 - June 30, 1982*)

Severity Level I	0
Severity Level II	0
Severity Level III	1
Severity Level IV	4
Severity Level V	3
Deviation	1

Total Violations 38 Total Deviations 2

B. Violations Vs. Functional Area

(1) September 1, 1981 - March 9, 1982

FUNCTIONAL AREAS	Severity Levels I	II	III	IV	V	VI	DEV
1. Plant Operations	0	0	3	3	5	0	0
2. Radiological Controls	0	0	1	1	3	0	1
3. Maintenance	0	0	0	0	2	0	0
4. Surveillance	0	0	0	1	1	1	0
5. Fire Protection	0	0	0	0	5	0	0
6. Emergency Preparedness	0	0	1	0	0	0	0
7. Security & Safeguards	0	0	1	0	0	0	0
8. Refueling	0	0	0	0	1	0	0
9. Licensing Activities	0	0	0	0	0	1	0
Totals	0	0	6	5	17	2	1

TABLE 5 (Continued)

B. Violations Vs. Functional Area

(2) March 10, 1982 - June 30, 1982*

FUNCTIONAL AREAS	Severity Levels I	II	III	IV	V	DEV
1. Plant Operations	0	0	0	1	1	1
2. Radiological Controls*	0	0	0	1	0	0
3. Maintenance	0	0	0	1	0	0
4. Surveillance	0	0	0	0	2	0
5. Fire Protection*	0	0	0	0	0	0
6. Emergency Preparedness	0	0	0	0	0	0
7. Security & Safeguards	0	0	1	0	0	0
8. Refueling	0	0	0	1	0	0
9. Licensing Activities	0	0	0	1	0	0
Totals	0	0	1	4	3	1

Total Violations = 38
Total Deviations = 2

* Does not include the following reports, not yet issued:

82-19 - Resident Inspector
82-20 - Special Health Physics

TABLE 5 (Continued)

C. Summary

Inspection No.	Inspection Date	Subject	Req.	Sev.	Area
81-18	June 15 - Sept. 30	Failure to have an operable combustible gas control system (multiple examples of design errors, procedural and drawing errors, and inadequate safety reviews)	10 CFR 50.44	III	1 (9)*
81-18	June 15 - Sept. 30	Failure to inform the NRC of the erroneous statement that an installed system met the requirements of 10 CFR 50.44 - Material False Statement	T.S.	III	1 (9)*
81-19	August 18 - Sept. 30	Failure to follow station procedure	T.S.	V	1
81-19	August 18 - Sept. 30	Failure to perform a safety evaluation prior to disabling protection for an RHR pump	10 CFR 50.59	IV	1
81-21	August 31 - Oct. 2	Failure to post a high radiation area	T.S.	IV	2
81-21	August 31 - Oct. 2	Failure to adhere to radiation protection procedures for radiation work permits.	T.S.	V	2
81-21	August 31 - Oct. 2	Failure to post copies of NOV's involving radiation protection	10 CFR 19	V	2
81-22	Sept. 16 - Sept. 17	RCIC containment isolation valves were left open when their control instrumentation was inoperable	T.S.	III	1
81-24	Dec. 1, 1981- Jan. 18, 1982	Operation at drywell temperatures above FSAR description without adequate safety evaluations	10 CFR 50.59	IV	1
81-24	Dec. 1, 1981- Jan. 18, 1982	Failure to adequately prepare and implement procedures for coping with high drywell temperatures	T.S.	V	1(4)*

TABLE 5 (Continued)

C. Summary

Inspection No.	Inspection Date	Subject	Req.	Sev.	Ar
81-24	Dec. 1, 1981- Jan. 18, 1982	Failure to promptly evaluate and correct conditions adverse to quality	10 CFR 50 App B	V	[illegible]
81-24	Dec. 1, 1981- Jan. 18, 1982	Security access card keys not properly controlled	Security Plan	III	7
81-24	Dec. 1, 1981- Jan. 18, 1982	Combustibles were not removed from area near hot work	T.S.	V	5
81-24	Dec. 1, 1981- Jan. 18, 1982	Improper equipment tagging	T.S.	V	1 (
81-25	Oct. 15 - Oct. 18, 1981	Failure to have all ORC members present at a pre-refueling meeting	T.S.	V	8
81-26	July 20, 1981	Transported radioactive materials with liquid in drums	10 CFR 30.41	III	2
81-35	Nov. 1 - Nov. 30	Control/Storage of combustible gas cylinders was not in accordance with station procedures	T.S.	V	5
81-35	Nov. 1 - Nov. 30	Failure to establish and implement procedures for the control of combustible scrap, waste, debris	T.S.	V	5
81-35	Nov. 1 - Nov. 30	Failure to establish and implement procedures for the control of combustible oil	T.S.	V	5
81-35	Nov. 1 - Nov. 30	Control of foreign material during repairs to MSIV's was not in accordance with procedure	T.S.	V	3
81-36	Nov. 30, 1981- Dec. 4, 1981	A master surveillance schedule was not established	T.S.	VI	4
81-36	Nov. 30, 1981- Dec. 4, 1981	T.S. Amendments were not properly entered into controlled volumes	T.S.	VI	9 (1

TABLE 5 (Continued)

C. Summary

Inspection No.	Inspection Date	Subject	Req.	Sev.	Are
81-36	Nov. 30, 1981-Dec. 4, 1981	Program and procedures were not established for housekeeping and system cleaning that meet the standards stated in the QA Manual	10 CFR 50 App B QAM	V	3 (
82-01	Jan. 18, 1982-Feb. 28, 1982	Workers were not properly instructed of the storage and transfer of radioactive resins	10 CFR 19.12	V	2
82-01	Jan. 18, 1982-Feb. 28, 1982	Procedures were not adequately established and implemented to provide required numbers of SCBA units for fighting fires	T.S.	V	5
82-02	Jan. 1 - Jan. 15, 1982	Uncalibrated brush recorders were used during RPS surveillance	10 CFR 50 App B	V	4
82-02	Jan. 1 - Jan. 15, 1982	Maintenance activities were performed without using approved procedures	T.S.	IV	3
82-02	Jan. 1 - Jan. 15, 1982	Instrumentation was not calibrated at frequency specified in station procedures	T.S.	V	4
82-02	Jan. 1 - Jan. 15, 1982	Improper control of access to Vital Areas	Security Plan	III	7
82-04	Jan. 25 - Jan. 29, 1982	Failure to implement procedures for LLRT and drawing change revisions	T.S.	V	4 (
82-04	Jan. 25 - Jan. 29, 1982	Drawings and procedures did not identify the as-built condition of valves in piping systems	10 CFR 50 App B	IV	1
82-05	Feb. 1 - Feb. 5, 1982	Untimely corrective action to internal QA Audit Deficiency Reports	10 CFR 50 App B	V	1
82-06	Feb. 10 - Feb. 12, 1982	Training and requal. program for personnel who operate and process radioactive waste not implemented as committed	Committment IEB 79-19	DEV	2

TABLE 5 (Continued)

C. Summary

Inspection No.	Inspection Date	Subject	Req.	Sev.	Area
N/A	Feb. 12, 1982	Prompt Notification System (sirens) not installed by February 1, 1982	10 CFR 50.54	III	6
82-10	March 1 - April 4, 1982	Performed maintenance on valve with red tag attached	T.S.	V	1 (3)
82-10	March 1 - April 4, 1982	Plant shielding study mod. (truck lock door panel) not completed as stated in response to NRR	NUREG 0737	DEV	6
82-11	Feb. 25 - Feb. 28, 1982	An unauthorized adjustment was made to a leaking flange during the conduct of the PCILRT	10 CFR 50 App J	IV	4
82-12	April 5 - May 9, 1982	Failure to follow actions required by T.S. with inoperable reactor vessel water level instrumentation	T.S.	IV	1
82-13	April 12 - April 16, 1982	Inadequate design control, for interfaces and verification	10 CFR 50 App B	IV	9 (5)
82-16	May 10 - June 13, 1982	Failure to lock or control access to a high radiation area (stuck TIP drive)	T.S.	IV	2

( )* secondary area involved

Testimony Submitted by
Stephen J. Sweeney
President and Chief Executive Officer
Boston Edison Company
to the
U.S. House of Representatives
Subcommittee on Energy Conservation and Power
of the
Committee on Energy and Commerce
July 16, 1986

INTRODUCTION

Boston Edison Company appreciates the opportunity to address a number of issues involving the Pilgrim Nuclear Power Station which are of concern to this committee, the Nuclear Regulatory Commission and to me personally. At the outset let me stress that most of the issues raised by the NRC in various reports and by this committee were of concern to me more than a year ago and that corrective actions were underway as early as September 1985. As discussed in the following pages, those actions are meeting with success.

In today's environment, public concern about nuclear power is heightened substantially. Public confidence in the technology and the institutions involved with it is at a low point.

Boston Edison Company has a great deal of work to do in this environment to gain public confidence in our ability to manage and run Pilgrim Station. I personally will not be satisfied until we have achieved a level of public and regulatory confidence that allows Pilgrim Station to place among the best. We have made an internal commitment to measure ourselves against the best, which is a significant change in how we are approaching our current problems.

As will be evident in reviewing our testimony, we were historically plagued by not looking outside to measure our success and to undertake the intensive self-criticism necessary to assess performance honestly and objectively. That has changed. We are moving in a new direction, one based on rising standards of excellence which are set, not by regulation, but by the performance of those plants judged to be among the best.

It should be noted that the concerns we are addressing today are different from those for which we were fined in 1982. The issues then were safety-related and failure to comply with regulations. Today, the issues are not directly related either to compliance or to safety. They instead involve a rising standard of performance going far beyond mere compliance with rules to a much broader dimension in the regulatory process. That new dimension is one that dictates comparisons and success is measured by relative performance. We endorse it.

Before discussing our current activities, let me offer perspectives on three time frames.

The first time frame is 1972 to 1979 and Three Mile Island. Our major management shortcoming then was the failure to recognize fully that the operational and managerial demands placed on a nuclear power plant are very different from those of a conventional fossil-fired power plant. Boston Edison structured its nuclear organization as part of a traditional operating arm. While many members of the Pilgrim Station organization recognized the differences in the technologies, they had limited success in arguing for the resources necessary to meet a set of standards that already were rising fairly rapidly. This was also a period of poor quality fuel which resulted in significant internal radiological problems that affected the plant for years.

Then came Three Mile Island. From March 1979 until early 1982 the same structure, under one vice president, attempted to deal with the post-TMI demands on operations and engineering, while at the same time pursuing a construction permit for a second unit at Pilgrim Station. The staff increased dramatically to 200, 300 and then 400 people. It was an unreasonable workload for the structure and we paid a costly penalty for not recognizing it -- $550,000 in early 1982.

From 1982 until mid-1985, we operated with a new and improved management structure that recognized the unique nature of nuclear power plants and the demands of the post-TMI period. We committed the financial and human resources necessary to upgrade equipment and hardware and to install various improvement programs to meet NRC concerns. More than $300 million went into hardware improvements, the staff grew from 400 to nearly 600 people and the organization was restructured under a senior vice president and two vice presidents. We achieved a significant measure of success for which we were recognized by the NRC and in the plant's outstanding operating performance in both 1983 and 1985.

But in managing the equipment improvements and the new management systems and programs we put in place, we didn't focus enough on what was going on outside the company in the industry and within the NRC. What we didn't see because we were so internally focused was the fact that the industry itself and the NRC were looking under, behind and around all of the hardware and management programs reaching for excellence.

In our case, not seeing that put us in a defensive posture. We weren't identifying weaknesses that were inhibiting continued improvement ourselves. We weren't being self-critical, others had to tell us what was wrong. We weren't holding managers accountable enough for the end result of an action or inaction. We weren't working well enough together.

Those problems were very real, very serious and of great concern to me and to the Board of Directors. I became particularly concerned about management performance, not management systems and programs, but the results of those systems and programs as measured by effectiveness. In mid-1985, I asked the Vice President of Nuclear Operations to investigate my concerns, which he shared, and issue a report. As he progressed through the study, he

and other managers began identifying needs. In September 1985, we increased the operator staff by a third. In December, we reorganized plant management to improve reporting relationships and build in greater accountability.

In February 1986, the NRC issued their report. They said the same thing: We had attitude problems that were seriously interfering with our ability to get the results we should be seeing given our financial and human resource commitments.

By March, we had taken a number of other actions, all of which are detailed in the following pages. We began eliminating those old attitudes that were not serving us well and began to inject the nuclear organization with the skills and perspectives necessary to achieve a measure of performance which would place us among the best. In the same time frame we made further human resource commitments. We increased our emergency planning complement five-fold, we increased the number of radiological technicians 35 percent and we implemented an apprentice program for the long-term development of skilled personnel.

The shutdown on April 12 gave us an opportunity to accelerate that change. A different approach to problem solving was taken. It stressed a more deliberative and integrated effort at identifying root causes and taking corrective action. In early May, a new plant manager and a new operations section head were brought on board, nearly rounding out a new 16 member plant management team. Of the 16, 11 were new in their positions in the past 8 months and 5 were new to the company. We have new perspectives. We have people with strong nuclear navy backgrounds, people with NRC inspection experience and people who grew up professionally not in conventional fossil-fired power plants, but in nuclear plants.

On May 27, having accepted that management is just as important as equipment, we took the unprecedented step of giving the new plant manager and his new team additional time, while the unit was shut down, to become familiar with the issues, to accelerate the development of new programs and, most importantly, to infuse the organization with attitudes and behavior that will make those programs work. These are attitudes that demand self-criticism, demand accountability, demand teamwork and demand results which go far beyond mere compliance with a set of rules, regulations and technical specifications.

Excellence is our goal. But excellence is, after all, an attitude which accepts nothing less. Achieving excellence will not be easy; we know that. We know our problems. We have made the human resource and financial commitment to solve them. We know what has to be done and we are doing it. As a result, I am confident we will, in time, demonstrate to you, to the Nuclear Regulatory Commission and the public that we have responded effectively to the concerns which are shared by all of us.

As a final point, I know that an important question on the minds of many people is "why should Boston Edison be believed today given the problems over the years at Pilgrim Station?"

I hope I already answered that question in part. It is perhaps the most difficult question and can only be answered fully by performance over time. But in closing I would underscore two major differences today from the past. The first is our forceful acceptance of the need for us to measure our performance against an ever increasing set of standards set by those plants judged by industry and the NRC to be among the best.

The second is the fact that we have adopted the basic principles and criteria for good management that are applied to the nuclear navy. They are the same principles and criteria that are in evidence at all of the top rated plants.

This is a demanding industry with a vital role in the social and economic health of the country. It operates in a demanding regulatory climate as evidenced by this hearing today. For us as a company with a single unit to succeed in this environment means that we must impose on ourselves the highest standards of performance found in the industry. We are doing just that.

The balance of this filed testimony is arranged in the order of the six sections on which you requested information in your letter of July 2, 1986. We have repeated your request at the beginning of each section.

BOSTON EDISON

Ralph G. Bird
Senior Vice President — Nuclear

July 8, 1987

BECo Ltr. 87-111

Mr. Steven A. Varga, Director
Division of Reactor Projects, I/II
United States Nuclear Regulatory Commission
Washington, D. C. 20555

License DPR-35
Docket 50-293

INFORMATION REGARDING PILGRIM STATION
SAFETY ENHANCEMENT PROGRAM

Reference: NRC Letter, Proposed Enhancement to the Mark I Containment - Pilgrim Station, dated April 30, 1987

Dear Mr. Varga:

As agreed during July 1, 1987 discussions between Frank Miraglia, USNRC, and John Fulton, Boston Edison Company (BECo), we are submitting this response to your letter to BECo dated April 30, 1987. Enclosed for your information is a detailed description of the Safety Enhancement Program (SEP) hardware changes that BECo has voluntarily elected to implement for Pilgrim Nuclear Power Station (PNPS). The description of procedural changes and personnel training will be furnished under separate cover. A current implementation schedule for the SEP modifications will also be furnished separately. A condition is that the modifications scheduled during the current outage do not require prior governmental approval. Should this condition not be met for any of these voluntary modifications, with the result that the current implementation schedule must be extended, then BECo will be unable to implement the affected modifications during the current outage.

Additional documentation will be available for review by the NRC Staff at BECo's Braintree offices or the PNPS site. Cognizant BECo personnel will be available at those locations for discussion with the Staff

Current evaluations of the benefit from the SEP modifications are based primarily upon extensive, although still preliminary, analyses and qualitative engineering judgments. Final quantitative analysis must, in accordance with the stated long term goal of the SEP, await final identification of modifications and completion of the Individual Plant Evaluation (IPE). BECo understands that the NRC intends to issue later this year a generic letter requiring all plants to perform an IPE as part of the

closure of the Commission's Severe Accident Policy Statement, when that requirement is issued. BECo expects to complete the IPE and promptly make the results available in accordance with the review process prescribed by the generic letter.

Please feel free to contact me or Edward Howard, of my staff at (617) 849-8900 if you have any questions concerning the matter addressed in this response.

R. G. Bird

Enclosures

cc: Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

Senior NRC Resident Inspector
Pilgrim Nuclear Power Station

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Michael S. Dukakis
Governor

Charles V. Barry
Secretary

EXECUTIVE SUMMARY OF THE PROGRESS
REPORT ON EMERGENCY PREPAREDNESS FOR AN
ACCIDENT AT PILGRIM NUCLEAR POWER STATION

I. EXECUTIVE SUMMARY

On December 16, 1986, I transmitted to the Governor a comprehensive report on safety at Pilgrim Nuclear Power Station. This is a progress report about the activities by state and local government, the Boston Edison Company, the U.S. Nuclear Regulatory Commission and the Federal Emergency Management Agency since that time to address the concerns we found.

In April of 1986, operation of Pilgrim Station was halted because of several mechanical problems. The U.S. Nuclear Regulatory Commission has ordered that the Boston Edison Company keep the plant shut until a variety of corrections regarding the management and operation of Pilgrim Station have been made. As of this date, Pilgrim remains closed, although Boston Edison has asked the NRC for permission to restart the facility.

In my December, 1986 report, I concluded that Radiological Emergency Response Plans for the Pilgrim facility were not adequate to protect the public health and safety. I further identified serious problems regarding the management of the power plant and the engineering safety of the reactor. In my view, these three issues -- emergency planning, plant management, and reactor safety -- were so serious and the weaknesses and deficiencies so severe that I recommended that the plant should not be allowed to restart unless and until these concerns had been satisfactorily addressed.

There has been a considerable amount of activity at all levels to address these concerns since my report was issued. In some cases substantial progress has been made. In particular, the Massachusetts Civil Defense Agency and Office of Emergency Preparedness has devoted all available staff and resources to the effort of developing the best possible emergency response plans.

MCDA/OEP has instituted a planning process at the state and local level and revisions are well under way. In addition, a new system has been installed for off-site notification in the event of an accident at Pilgrim Station. We now have the advantage of a new Nuclear Safety Emergency Preparedness Program and a professional staff which for the first time is dedicated to off-site emergency preparedness and planning. This new program and staff are the result of the Governor's initiative in the Fiscal Year 1988 budget. The Governor has requested additional funds for the new program as a supplementary appropriation for the current fiscal year.

Nonetheless, I continue to make the finding that adequate plans for response to an accident at Pilgrim Station do not exist, and I reaffirm my earlier position that the Pilgrim facility should not be allowed to restart until such plans have been fully developed and have been demonstrated to be workable and effective through a graded exercise of all plans and facilities.

This finding is based on the fact that in every critical area in which I found a deficiency to exist in my December, 1986 report substantial work remains to be done before a determination of adequacy can be made. For example, analysis of a new Evacuation Time Estimate and Traffic Management Study by state and local authorities is still underway. The ETE is one of the most critical pieces of information in the entire process and the foundation of effective emergency planning. Our preliminary review of the ETE suggests that more resources are required to successfully implement the traffic management plan. The shelter survey which was prepared by Boston Edison has been returned to the company for further study because is was found to be woefully inadequate.

Plans and implementing procedures for special needs populations remain incomplete, and it may be necessary to undertake an additional survey of people who would need assistance in emergency response or to do further statistical analysis of this matter. The development of implementing procedures and the identification of resources to care for school age populations also requires additional work. In regard to the adequacy of reception centers, the question of need for a facility to serve people in the northern portion of the EPZ remains open. We cannot make decisions on the need for or identification of a third reception center until Boston Edison has provided us with an analysis of the adequacy of the existing two reception facilities.

With regard to plant management, we have seen numerous changes in Boston Edison's personnel and organization for management of Pilgrim Station. The most notable change is the appointment of Mr. Ralph G. Bird as Senior Vice President, Nuclear, who directly reports to the company's chief executive officer. Yet despite these changes, I cannot say at this time that the management problems have been fully resolved. For example, we are concerned about recent incidents including violation of NRC regulations in the area of plant security, and allegations of excessive overtime worked by utility employees. We are also concerned by Boston Edison's action to refuel Pilgrim Station without having responded to my objections and the objections of several state legislators.

The Systematic Assessment of Licensee Performance (SALP) perfomed by the NRC is the most comprehensive study and report on nuclear management at Pilgrim Station. The last SALP report was issued on April 8, 1987 and it showed deterioration in several aspects of nuclear management since the last report. Until a similarly comprehensive analysis of management under the new organization has been conducted and the above concerns resolved, I cannot say that our management concerns have been addressed.

With regard to reactor safety issues, we have carefully reviewed Boston Edison's "Safety Enhancement Program" (SEP). The SEP has been undertaken since the issuance of a "Draft Generic Letter" from Mr. Robert Bernero of the NRC concerning safety at Mark I containment structures such as the Pilgrim containment. We have two major concerns in the area of reactor safety.

First, despite the fact that the NRC letter was prompted by a finding that there was a high probability of Mark I containment failure during certain severe accident scenarios, the NRC has yet to adopt an official position regarding safety enhancement. Moreover, according to NRC Region I Administrator William Russell, with whom my staff and other state officials met at NRC's regional offices in King of Prussia, Pennsylvania on October 8, 1987, enhancement of the Mark I containment at Pilgrim is not an issue that the NRC believes must be finally resolved before restart.

Our second concern is the uncertainty that continues to exist about at least one feature of the Boston Edison SEP, the direct torus vent. No concensus has been reached on whether installation of the torus vent creates unreviewed

safety issues or if the torus vent is authorized, how it will be used in the event of a severe nuclear accident.

The findings of my December, 1986 report have been strengthened by two other analyses of safety at Pilgrim Station. The Special Joint Legislative Commission to Study Pilgrim Station has issued its report which further studies and documents many of the same safety concerns. In addition, the Federal Emergency Management Agency has issued a Self-Initiated Review of plans for response to an accident at Pilgrim Station. Based on several of the issues raised in my report FEMA has changed its interim finding and now agrees that the off-site plans for an accident at Pilgrim are not adequate.

FEMA has transmitted their new finding to the Nuclear Regulatory Commission. However, the NRC has yet to indicate whether or not development of adequate off-site plans will be a condition to the restart of Pilgrim. We are not satisfied with the view recently expressed by the NRC Region I staff that emergency planning problems must be "addressed" before restart. Such problems must be satisfactorily resolved before restart. Off-site response plans are just as important as nuclear management and reactor safety in protecting the public from an accidental release of radiation.

Therefore, for these reasons -- the absence of adequate emergency response plans, lack of demonstrable assurance that management problems have been solved, and uncertainty about the safety of the Mark I containment structure -- I continue to find that Boston Edison has not met the heavy burden of showing readiness to restart the Pilgrim Nuclear Power Plant. I also continue to believe that it remains to be seen if adequate emergency response plans can be developed and if all other safety issues can be resolved to our satisfaction.

Finally, I recommend that in light of the number of outstanding issues and their complexity, and Boston Edison's evident determination to press ahead with the effort to restart, that there should be a full scale public hearing by the NRC before any decision is made regarding the restart of Pilgrim Station.

October 14, 1987

CHARLES V. BARRY
SECRETARY OF PUBLIC SAFETY

1051J

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE DEPARTMENT
CIVIL DEFENSE AGENCY AND OFFICE OF EMERGENCY PREPAREDNESS
400 WORCESTER ROAD
P O BOX 1496
FRAMINGHAM, MASS 01701-0317

MICHAEL S. DUKAKIS
GOVERNOR

ROBERT J BOULAY
DIRECTOR

September 18, 1987

Mr. Ralph Bird
Senior Vice President
Boston Edison Company
800 Boylston Street
Boston, Massachusetts

Dear Mr. Bird:

My staff has reviewed the August, 1987 "Study to Identify Potential Shelters in EPZ Coastal Region of the Pilgrim Nuclear Power Station," which was prepared for you by Stone and Webster.

We find that this study is deficient in several respects and that additional work is required to provide information to local officials which is sufficient to support development of implementable shelter utilization plans. I have attached a copy of a memorandum prepared by my staff which details our specific concerns regarding this study.

If you have any questions or observations regarding our evaluation, please contact Buzz Hausner of my staff.

Thank you for your cooperation in this matter.

Sincerely,

Robert J. Boulay
Director

cc: Assistant Secretary, Peter W. Agens, Jr.
Deputy Director, John L. Lovering
Mr. Buzz Hausner

EXECUTIVE DEPARTMENT
CIVIL DEFENSE AGENCY AND OFFICE OF EMERGENCY PREPAREDNESS
400 WORCESTER ROAD
P O BOX 1496
FRAMINGHAM, MASS 01701-0317

MICHAEL S DUKAKIS
GOVERNOR

ROBERT J BOULAY
DIRECTOR

TO: DIRECTOR BOULAY

FROM: BUZZ HAUSNER

IN RE: SHELTER SURVEY OF PILGRIM EPZ PREPARED BY BOSTON EDISON COMPANY

DATE: SEPTEMBER 11, 1987

We have made a preliminary review of the shelter survey of the Pilgrim EPZ which was prepared by the Boston Edison Company and its consultants. While this document compiles some very useful data, we feel that more work must be done to estimate the effectiveness of shelter as a protective action.

Our principal concern is that we must be able to put data in the hands of local officials which are sufficient for the development of shelter utilization plans for all areas of all five communities within the Pilgrim EPZ. With this in mind, we have the following comments.

- The survey only covers an area approximately one mile wide along the coast. The shelter capabilities of the entire EPZ must be surveyed and reported.

- The survey does not separate out those structures which could "most reasonably" be used as shelters from those where shelter is less appropriate.

  For instance, it would help to have a separate list of public buildings and facilities for each town, including an estimation of the actual useable shelter space and protective factors for shelter under government authority.

- Many of the shelters listed, such as jewelry stores and pharmacies are clearly not suitable for public shelter. In a severe emergency, every available resource will of course be put to use. However, to develop an implementable shelter utilization plan, local officials must be able to match estimated needs with the most appropriate resources available.

Director Boulay
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- Regarding protection of the beach population, the survey identifies shelters within a mile of the coast but does not indicate the distances that beach goers would have to travel to find shelter. In addition, the survey must demonstrate that adequate proximate shelter is available for the total population at the individual beaches.

  For instance, Duxbury beach is about seven miles long and the survey should indicate the distance people at Saquish Head are required to travel to reach adequate shelter. Further, an implementable shelter utilization plan must demonstrate that the nearest shelter would not be full to capacity before the people at the most remote points of the beaches arrived.

- The survey must identify adequate shelter which is handicapped accessible.

- The survey does not distinguish between available space and usable space. For instance, residents of Plymouth have indicated to us that some basements listed in the survey are no more than crawl spaces. Crawl spaces cannot be considered for public shelter. Further, in most buildings, a good deal of floor area will be occupied by machinery, counters, office furniture, et cetera. The survey must identify accurately the actual useable shelter space available in each structure.

- Stone and Webster uses a FEMA nuclear attack value of ten square feet per person to estimate the potential population which can be sheltered. Local Civil Defense Officials may wish to allocate more space -- up to twenty square feet per person -- in their utilization plans. The value used in the survey overestimates the potential capacity of various buildings. We doubt that 17,000 people can be sheltered at Duxbury High School, or that 89,700 can be sheltered at the 5 Cordage Park Buildings.

- The survey must demonstrate that public shelters are free from asbestos and other environmental hazards.

- The report estimates residential "sheltering capability" in individual communities as between 53% and 81%. These figures indicate that a significant number of residents do not have adequate domestic shelter and emphasize the need for a full study of public shelter capacities throughout the entire EPZ.

Director Boulay
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Further, even if it can be established that the vast majority of residences offer adequate shelter, local officials must be prepared to offer public shelter of a known protective capability to residents who demand assistance.

- This report makes no definitive statement of what constitutes adequate shelter to protect people from the effects of a radiological release from Pilgrim Station. This is necessary to determine what facilities are most appropriate for a local shelter utilization plan and to determine the public shelter needs of each community.

In summary, we would say that this survey is a useful beginning but that much more work is required before we can assess our ability to develop implementable shelter utilization plans consistent with the public safety concerns in Secretary Barry's report to the Governor.

cc: Assistant Secretary Peter W. Agnes, Jr.
Deputy Director John L. Lovering

BOSTON EDISON
Executive Offices
800 Boylston Street
Boston, Massachusetts 02199

Ralph G. Bird
Senior Vice President — Nuclear

September 17, 1987
BECo Ltr. #87-146

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Docket 50-293
License No. DPR-35

Subject: Boston Edison Company Request for Exemption from 10 CFR Part 50, Appendix E, Section IV.F.

Dear Sir:

In accordance with 10 CFR section 50.12(a), Boston Edison Company requests that the Nuclear Regulatory Commission (NRC) grant a one-time exemption from the requirements of 10 CFR Part 50, Appendix E, Section IV.F., that would authorize the next biennial full participation emergency preparedness exercise for the Pilgrim Nuclear Power Station (Pilgrim) to be conducted in the second quarter of 1988. The schedule for future biennial exercises will not be affected by this one-time exemption, but rather will continue to provide that such exercises will be conducted every second year (i.e., the following biennial exercise will be held in 1989).

The proposed deferral of the full participation exercise has been discussed with the Commonwealth of Massachusetts (Commonwealth) and local emergency response officials. All of the parties have indicated that they support the proposal.

The request will not affect the onsite exercise at Pilgrim planned for December 9, 1987.

The requested exemption is necessary because the Commonwealth, the local governments within the ten-mile plume exposure pathway emergency planning zone (EPZ) and the two emergency reception center communities are at present engaged in implementing numerous improvements in their offsite emergency preparedness programs, with the assistance of Boston Edison. These improvements include revision of the emergency plans of the local governments, revision of the Massachusetts Civil Defense Agency (MCDA) Area II plan as well as the Commonwealth's state-wide plan, the development of revised related procedures, the development and implementation of training programs for officials and emergency personnel, and the upgrading of Emergency Operation Centers (EOC's). A substantial commitment of resources and time has been made to accomplish these improvements, and the work is expected to continue through the remainder of the year and early 1988.

In view of these extensive ongoing efforts, the Commonwealth and the local governments have indicated that they are not able to participate in an exercise during calendar year 1987. Moreover, it is apparent that under these circumstances, conduct of the full participation exercise will be much more effective after the ongoing improvements have been implemented. In granting one-time exemptions authorizing deferral of exercises for licensed plants in the past, the NRC has recognized that the most effective and beneficial exercises are those which include the full-scale participation of State and local governments and that it is appropriate to defer an exercise until program revisions or facility improvements have been completed.

Since the last full participation biennial exercise at Pilgrim, Boston Edison has held an onsite exercise at Pilgrim in December 1986; has held quarterly onsite drills in March, June and August of 1987; and has scheduled its annual onsite exercise for December 9, 1987 (in which the Commonwealth will exercise various offsite objectives as described in BECo Ltr. #87 -147 "Scheduling of Pilgrim Onsite Exercise"). The previous exercise and drills have included limited participation by the Commonwealth, and the March and June 1987 drills included limited participation by several of the towns. The towns within the EPZ have also cooperated in the full scale siren test reviewed by FEMA, which was conducted on September 29, 1986. In addition to its activities involving Pilgrim, the Commonwealth has also participated in full participation exercises at the Yankee Nuclear Power Station in June 1986 and is scheduled to participate in a full participation exercise at the Vermont Yankee Nuclear Generating Station during the week of November 29, 1987.

This request meets a number of the special circumstances listed in Section 50.12(a)(2)

First, granting the request will provide only temporary relief from the applicable regulation and the licensee has made good faith efforts to comply with the regulation. Over the past year, Boston Edison has assisted Commonwealth and local authorities in a variety of ways to accomplish as many improvements as possible in their offsite emergency response programs. For example, Boston Edison has developed substantive information for the enhancement of those programs. The major products of this effort include the "Pilgrim Station Evacuation Time Estimates and Traffic Management Plan Update" (August 18, 1987) prepared by KLD Associates, Inc. and "A Study to Identify Potential Shelters in the EPZ Coastline Region of Pilgrim Nuclear Power Station" (August 1987) prepared by Stone & Webster Engineering Corporation, as well as information generated in surveys to identify the special needs and transportation dependent populations within the EPZ.

In addition, Boston Edison is providing assistance to the local governments in their offsite emergency program enhancement efforts in accordance with the Massachusetts Civil Defense Act of 1950 (Chapter 639, Section 15, Acts of 1950 as amended). This assistance includes the provision of two professional planners to work under the direction of the officials of each town within the EPZ in upgrading its plan, procedures and training; one

professional planner to assist each reception center community; and four professional planners working under the direction of MCDA in the upgrading of the MCDA Area II and Commonwealth program. In the first half of 1987, Boston Edison provided introductory emergency training to about 350 personnel within the five towns in the EPZ and enhanced introductory training modules are currently being prepared for review by the MCDA prior to further implementation. The planners provided by Boston Edison have also begun to prepare task-based modules for training of specific categories of emergency personnel and will be available to participate in the training programs. In addition, Boston Edison is executing agreements with each of the five towns within the EPZ, as well as the two reception center communities, for assistance in the renovation of their EOC's. Moreover, four of the five EPZ towns and both reception center communities, to date, have accepted BECo's offer of funding support for full-time civil defense staff positions.

Second, literal compliance with the regulation would not serve its underlying purpose and would result in undue hardship to Commonwealth and local emergency response agencies by requiring an exercise of portions of the offsite emergency plans that are in the process of significant revision and improvement. This would necessarily involve disruption of the ongoing process of implementing these changes, and consequently, the imposition of additional costs and delay in accomplishing the planned improvements. The NRC's emergency exercise requirements clearly were not intended to disrupt the orderly implementation of improvements in such manner.

Finally, because granting the request will allow work to proceed without disruption, it will result in a net benefit to the public health and safety. The NRC has acknowledged that flexibility is appropriate in applying emergency planning requirements. This flexible approach is especially appropriate in this case, where granting the request will facilitate more prompt and effective implementation of improvements.

For all these reasons, Boston Edison asks that NRC grant the requested exemption. In accordance with 10 CFR §170.12(c), a fee of one hundred and fifty dollars ($150.00) will be electronically mailed to your offices. If you should require any additional information in connection with this request, please contact either myself or Mr. Ron Varley of my staff (telephone: 617 - 424-3832).

R G Bird
Ralph G. Bird

RAL/dlw

U. S. Nuclear Regulatory Commission
Page 4

cc: Dr. Thomas E. Murley, Director
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Mr. Edward Thomas
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J. W. McCormack Post Office and Court House
Boston, MA 02109

Mr. Peter Agnes, Jr.
Commonwealth of MA
Assistant Secretary of Public Safety
1 Ashburton Place - Room 2133
Boston, MA 02108

U. S. Nuclear Regulatory Commission
Region 1 - 631 Park Avenue
King of Prussia, PA 19406

Senior NRC Resident Inspector
Pilgrim Nuclear Power Station
Rocky Hill Road
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Henry Vickers, Regional Director
FEMA - Region 1
J.W. McCormack Post Office and Court House
Boston, MA 02109

The CHAIRMAN. Thank you, Attorney General Shannon. Glad to see an old friend.

We'll move right along. I'm pleased to welcome the distinguished members of our third panel, representing the various branches in state government involved in the Pilgrim restart question.

I remember the days when the State Secretary of Energy, Sharon Pollard, was a freshman legislator; bright and enthusiastic, deeply committed to public service, now she has moved onto higher office, and I'm delighted that she has the same enthusiasm and is an aggressive champion of the public interest in the issues we've been discussing this evening. I'm delighted to have her with us.

Ms. POLLARD. Thank you, Senator.

The CHAIRMAN. Our new Public Health Commissioner, Deborah Prothrow-Stith, and this is her first public appearance this evening, was recently appointed to the position. Commissioner Prothrow-Stith will be discussing the important role the Department of Public Health will play in determining what public health impacts are associated with Pilgrim Power Plant. We are fortunate to have had breakfast with the Reverend Stith this morning, so we've been with the family all day.

Last, but not least, Assistant Secretary of Public Safety, Peter Agnes. Peter has perhaps the most difficult job of all because he is trying to make an unworkable evacuation plan workable. I'm looking forward to hearing from him. We'll start with Peter Agnes, left to right.

STATEMENTS OF PETER AGNES, ASSISTANT SECRETARY OF PUBLIC SAFETY; SHARON POLLARD, SECRETARY OF STATE OF ENERGY; AND DEBORAH PROTHROW-STITH, HEALTH COMMISSIONER

Mr. AGNES. Thank you, Mr. Chairman. I'm here on behalf of Secretary Charles Barry, who by Executive order is the Disaster Coordinator for the Commonwealth, and also by the Governor's designation, is the liaison officer for Massachusetts to the Nuclear Regulatory Commission, and in that capacity, the Secretary is the principal point of contact between State officials and the NRC.

At the outset, I would like to address a point that was made by one of the earlier speakers, Ann Waitkus-Arnold, concerning the use of potassium iodine, not from a public health standpoint, which the Commissioner of Public Health can do, but from a planning standpoint. And I want to correct a matter that was referred to in her testimony.

There is no plan today; there has never been to my knowledge a plan in the past and there will never be under the Dukakis administration, a plan that would leave behind any member of the community, be they a special needs person or otherwise, in the event of an evacuation by substituting some drug, such as potassium iodine, for the safe and secure care of that person. So no one should be misled into thinking that there is any thought given to leaving anyone behind during an evacuation who would require attention, care or evacuation.

Over the past 2 years, we have taken three major actions to respond to the health and safety concerns of the Pilgrim nuclear

power plant. First, we have prepared and filed with the Governor two comprehensive written reports, which other speakers here have referred to, the most recent of which was released just several weeks ago. And we would like to make those reports, which also were transmitted to the Nuclear Regulatory Commission and to FEMA, a part of the record of these proceedings.

These reports deal at great length with the history of emergency planning activities, both at the State and Federal level, and with the many specific problems associated with the Pilgrim plant. It is our opinion, to paraphrase the Federal Regulatory Standard, that the existing emergency plans for Pilgrim station are not adequate to protect the public health and safety in the event of a radiological emergency offsite; and that, therefore, the plant should not be allowed to restart unless and until adequate plans are developed, tested and approved by FEMA and the other safety related concerns have been resolved.

The CHAIRMAN. I'm to give you a couple more minutes.

Mr. AGNES. Thank you, Senator. I have said this on many occasions and I want to reiterate it tonight, our position has been clear and consistent in the past 2 years on this point. And one of the unfortunate things that we—excuse me—that we are facing is the lack on the part of the NRC a willingness to make clear precisely what corrections or changes it will insist upon in the emergency plans before the plant is restarted.

The second activity we have undertaken is to establish a new division in the State within the Civil Defense Agency devoted exclusively to nuclear emergency preparedness. Despite all of the activities that followed Three Mile Island, at the congressional level and at the State level, it is only in the last 2 years with an initiative taken by Governor Dukakis, that a new division devoted exclusively to this purpose has been established and devoted to emergency planning problems.

Third, for the first time again, a planning process has been put in place at the State level, which requires work on the part of the utility, local government and State government in an effort to develop adequate emergency plans.

I would like to conclude my remarks, Mr. Chairman, by commenting briefly, but more specifically on both the progress that has been made and also the problems that still remain.

On the progress side of the ledger, the Boston Edison Co. for the first time is a full partner with State and local officials in emergency planning. This is evidenced by financial support the company has provided to local communities and the fact that it has assigned over 20 people to work in the field with State and local government to aid in the development of draft plans. Planning resources have been invested by the company for the first time to help State and local officials and an inadequate emergency communication system that was identified in our earlier report has now been replaced by the company.

The company has produced several reports to aid in the emergency planning process, including a new evacuation time study that was given to the Commonwealth in the fall, and also a study concerning the adequacy of relying upon only two, instead of the previous three reception centers.

The CHAIRMAN. You've got 30 seconds, Peter.

Mr. AGNES. On the problem side of the ledger, we do have some severe problems that remain. We do not, as I indicated earlier, have a formally approved plan at this time. We do not have implementing procedures, which are the key part of the plan, to help deal with the evacuation and sheltering of special needs people and school children and the infirm and the elderly. The shelter study that has been submitted by the company is inadequate and we are insistent that additional work be done.

The reception center study that we just recently received and which is of great concern to residents here in the Plymouth area, while useful, is not sufficient in our opinion, and we have determined that a third reception center for the Pilgrim plant must be sited and we will make a decision in that regard as to a new site very shortly.

In conclusion, I would like to say that on balance, our diagnosis is that while the patient has improved; it remains quite ill and the prognosis is very uncertain. It remains to be seen, in our judgment, whether or not adequate emergency plans for the Pilgrim nuclear power plant can be developed, and as many of the speakers here before have indicated the only way to insure that the issues that we have identified are aired totally and fairly is to hold an adjudicatory hearing before restart. Thank you, Mr. Chairman.

[The prepared statement of Mr. Agnes follows:]

Michael S. Dukakis
Governor

Charles V. Barry
Secretary

The Commonwealth of Massachusetts
Executive Office of Public Safety
One Ashburton Place
Boston, Massachusetts 02108 (617) 727-7775

TESTIMONY OF PETER W. AGNES, JR.
ASSISTANT SECRETARY OF PUBLIC SAFETY
JANUARY 7, 1988

GOOD EVENING MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE. I AM HERE ON BEHALF OF SECRETARY CHARLES V. BARRY WHO BY EXECUTIVE ORDER IS THE DISASTER COORDINATOR FOR THE STATE AND BY DESIGNATION OF THE GOVERNOR IS THE LIAISON OFFICER FOR MASSACHUSETTS TO THE NUCLEAR REGULATORY COMMISSION. IN THE LATTER CAPACITY, THE SECRETARY IS THE PRINCIPAL POINT OF CONTACT BETWEEN STATE OFFICIALS AND THE N.R.C.

THE EXECUTIVE OFFICE OF PUBLIC SAFETY SUPERINTENDS TWO STATE AGENCIES WITH RESPONSIBILITY IN THIS AREA--THE DEPARTMENT OF PUBLIC SAFETY WHICH LICENSES NUCLEAR POWER PLANT OPERATORS AND THE CIVIL DEFENSE AGENCY WHICH IS RESPONSIBLE FOR PREPARING AND UPDATING EMREGENCY PLANS. MOREOVER, OTHER AGENCIES AND DIVISIONS WITHIN OUR SECRETARIAT WOULD PLAY A VITAL ROLE IN RESPONDING TO ANY EMERGENCY AT A NUCLEAR POWER PLANT WHERE THERE WAS A PUBLIC HEALTH OR SAFETY IMPACT OUTSIDE THE PLANT.

OVER THE PAST TWO YEARS, WE'VE TAKEN THREE MAJOR ACTIONS TO RESPOND TO THE HEALTH AND SAFETY CONCERNS AT THE PILGRIM PLANT.

FIRST, WE HAVE PREPARED AND FILED WITH THE GOVERNOR TWO COMPREHENSIVE WRITTEN REPORTS, THE MOST RECENT OF WHICH WAS

RELEASED JUST SEVERAL WEEKS AGO. I WOULD LIKE TO MAKE THESE REPORTS PART OF THE RECORD. THESE REPORTS DEAL AT LENGTH WITH THE HISTORY OF EMERGENCY PLANNING ACTIVITIES AT THE STATE AND FEDERAL LEVEL AND WITH THE SPECIFIC PROBLEMS ASSOCIATED WITH THE PILGRIM PLANT. IT IS OUR OPINION, TO PARAPHRASE THE FEDERAL REGULATORY STANDARD, THAT EXISTING EMERGENCY PLANS FOR PILGRIM STATION ARE NOT ADEQUATE TO PROTECT THE PUBLIC HEALTH AND SAFETY IN THE EVENT OF A RADIOLOGICAL EMERGENCY OFFSITE AND THAT THE PLANT SHOULD NOT BE ALLOWED TO RESTART UNLESS AND UNTIL ADEQUATE PLANS ARE DEVELOPED, TESTED AND APPROVED BY FEMA, AND THE OTHER SAFETY RELATED CONCERNS HAVE BEEN RESOLVED.

SECOND, WE HAVE ESTABLISHED A NEW DIVISION WITHIN THE CIVIL DEFENSE AGENCY WITH FISCAL OVESIGHT WITHIN EOPS DEVOTED EXCLUSIVELY TO NUCLEAR EMERGENCY PREPAREDNESS. THIS DIVISION IS TAKING A LEADERSHIP ROLE WITH LOCAL OFFICIALS AND UTILITY EMPLOYEES TO INSURE THAT, UNLIKE IN THE PAST, THERE IS ONLY ONE PLANNING PROCESS UNDER STATE SUPERVISION.

THIRD, WE HAVE ESTABLISHED A FORMAL PLANNING PROCESS TO CARRY OUT THE RESPONSIBILITIES ASSIGNED TO US UNDER STATE LAW. THE PROCESS INVOLVES THE UTILITY, COMMUNITY GROUPS, AND LOCAL AND STATE OFFICIALS MEETING TOGETHER REGULARLY TO ADDRESS EMERGENCY PREPAREDNESS ISSUES. IN DOING SO WE HAVE BEEN CAREFUL TO UNDERTAKE THIS PROCESS ON BEHALF OF THE THREE LICENSED PLANTS THAT AFFECT MASSACHUSETTS--PILGRIM, ROWE, AND VERNON--AT THE SAME TIME THAT WE CONTINUE TO ABIDE BY THE STATE'S POLICY THAT THERE SHALL BE NO PLANNING FOR THE SEABROOK PLANT.

I WOULD LIKE TO CONCLUDE MY REMARKS BY COMMENTING BRIEFLY, BUT MORE SPECIFICALLY ON SOME OF THE PROGRESS WE HAVE MADE AND PROBLEMS THAT STILL REMAIN.

ON THE PROGRESS SIDE OF THE LEDGER THE BOSTON EDISON COMPANY, FOR THE FIRST TIME, IS A FULL PARTNER WITH STATE AND LOCAL OFFICIALS IN THE EMERGENCY PLANNING EFFORT. THE UTILITY IS INVESTING IN THE PLANNING RESOURCES REQUIRED BY LOCAL AND STATE OFFICIALS. THE UTILIITY HAS REPLACED AN INADEQUATE EMERGENCY COMMUNICATIONS SYSTEM WITH A MUCH MORE SOPHISTICATED AND ENLARGED SYSTEM. THE UTILTY HAS ASSIGNED MORE THAN TWENTY PERSONS TO WORK WITH STATE AND LOCAL OFFICIALS AND HAS AIDED IN THE DEVELOPMENT OF DRAFT EMERGENCY PLANS WHICH ARE CURENTLY BEING REVIEWED BY LOCAL OFFICIALS. THE UTILITY HAS PRODUCED A NEW EVACUATION TIME ESTIMATE STUDY THAT WE RECEIVED DURING THE SUMMER AND HAS JUST PROVIDED US WITH A STUDY ON THE ADEQUACY OF USING ONLY THE TWO EXISTING RECEPTION CENTERS FOR THE EPZ. FINALLY THE UTILITY HAS MADE MAJOR CHANGES IN THE MANAGEMENT OF ITS NUCLEAR OPERATION AND INVESTED HEAVILY IN AN ON-SITE SAFETY ENHANCEMENT PROGRAM. ALSO, IT SHOULD BE NOTED THAT SPECIAL TASK FORCES HAVE BEEN ESTABLISHED TO ADDRESS THE SPECIAL NEEDS ISSUES AND TO RECOMMEND IMPROVEMENTS IN THE EMERGENCY PUBLIC INFORMATION MATERIAL THAT IS DISTRIBUTED ANNUALLY.THESE ARE SIGNIFICANT AND POSITIVE DEVELOPMENTS.

SIMILARLY, LOCAL OFFICIALS AND COMMUNITY GROUPS HAVE BEEN WORKING CLOSELY WITH THE STAFF OF THE NEW DIVISION OF NUCLEAR EMERGENCY SAFETY WITHIN CIVIL DEFENSE IN AN EFFORT TO DEVELOP THE BEST POSSIBLE EMERGENCY EVACUATION PLANS. IN MANY CASES, THIS EFFORT HAS MEANT THAT LOCAL AND STATE OFFICIALS HAVE WORKED NIGHTS AND WEEKENDS WITHOUT COMPENSATION.

ON THE PROBLEM SIDE OF THE LEDGER, WE DO NOT YET HAVE A FORMALLY APPROVED EMERGENCY PLAN TO RESPOND TO AN ACCIDENT AT PILGRIM STATION AND IT REMAINS TO BE SEEN WHETHER AN ADEQUATE PLAN CAN BE DEVELOPED. THE MOST IMPORTANT AND DIFFICULT PART OF THE EMERGENCY PLANS--THE DEVELOPMENT OF IMPLEMENTING PROCEDURES FOR PERSONS WITH SPECIAL NEEDS (SCHOOL CHILDREN, THE HANDICAPPED, THE INFIRM ETC.)--DO NOT YET EXIST EVEN IN DRAFT FORM. QUESTIONS HAVE BEEN RAISED ABOUT THE VALIDITY OF THE EVACUATION TIME ESTIMATES ANS WE HAVE DECIDED TO SUBMIT IT FOR AN OUTSIDE EVALUATION. THE SHELTERING STUDY PREPARED BY BECO. EARLIER IN THE YEAR IS INADEQUATE AND IT REMAINS TO BE SEEN IF THERE IS ADEQUATE SHELTER FOR THE POPULATION. A SURVEY OF PERSONS WITH SPECIAL NEEDS WAS PREPARED BY BECO. EARLIER IN THE YEAR WITHOUT STATE OR LOCAL PARTICIPATION OR APPROVAL AND IS INADEQUATE. THE RECEPTION CENTER STUDY WE RECEIVED TWO WEEKS AGO IS USEFUL, BUT WE HAVE CONCLUDED THAT A THIRD RECEPTION CENTER FOR THE NORTHERN EPZ RESIDENTS IS NECESSARY. WE WILL DESIGNATE A SITE IN A SHORT WHILE.

IN TERMS OF ON-SITE ACTIVITITES, WE ARE TROUBLED BY THE DECISION OF THE N.R.C. TO LEAVE UNRESOLVED THE SAFETY ISSUES

PRESENTED BY BOSTON EDISON COMPANY'S PROPOSAL TO INSTALL A DIRECT TORUS VENT TO MITIGATE THE CONSEQUENCES OF CERTAIN KINDS OF ACCIDENTS INVOLVING THE MARK ONE CONTAINMENT. THE EDISON INITIATIVE WAS TAKEN IN RESPONSE TO AN N.R.C. STAFF RECOMMENDATION. IN AUGUST, 1987, DR. TOM MURLEY WROTE TO BECO.AND ADVISED THEM THAT HE WAS NOT PREPARED TO APPROVE THE DIRECT VENT PROPOSAL WITHOUT FURTHER INFORMATION. TO OUR KNOWLLEDGE, BECO. HAS NOT SUBMITTED ITS RESPONSE. THIS IS JUST ONE REASON WHY OUR CALL UPON EDISON TO PRODUCE THE PROBABALISTIC RISK ANALYSIS WE BELIEVE HAS BEEN PREPARED IS SO IMPORTANT.

MANAGEMENT CONCERNS ALSO CONTINUE TO EXIST AT PILGRIM. THE MOST RECENT SYSTEMATIC ASSESSMENT OF LICENSEE PERFORMANCE REPORT (SALP) INDICATES THAT BECO. SCORED LOW IN A NUMBER OF SAFETY RELATED CATEGORIES. IN AUGUST, SECURITY VIOLATIONS OCCURRED AT THE PLANT THAT ARE THE SUBJECT OF AN ONGOING N.R.C. INVESTIGATION. A LOSS OF POWER INCIDENT ON NOVEMBER 12, 1987 WAS THE SUBJECT OF A RECENT AUGMENTED INSPECTION REPORT. ALTHOUGH NO VIOLATION OF REGULATORY REQUIREMENTS WAS FOUND, THE REPORT CRITICIZES THE OVERALL MANAGEMENT OF THE RECOVERY AND FOUND PLANNING WEAKNESS.

ON BALANCE, MY DIAGNOSIS IS THAT THE PATIENT HAS IMPROVED BUT REMAINS QUITE ILL AND THE PROGNOSIS IS UNCERTAIN.

FOR THESE REASONS, IT IS IMPERATIVE, IN OUR JUDGMENT, THAT THE N.R.C. HEED THE CALL BY GOVERNOR DUKAKIS AND ATTORNEY GENERAL SHANNON TO CONDUCT AN ADJUDICATORY HEARING BEFORE CONSIDERING ANY REQUEST TO RESTART THE PILGRIM PLANT.

I WOULD BE HAPPY TO TAKE ANY QUESTIONS.

RESPECTFULLY SUBMITTED

Peter W. Agnes, Jr.
Assistant Secretary

The CHAIRMAN. Thank you. Sharon Pollard.

Ms. POLLARD. Thank you, Senator. It is nice to be here, and I as well would like to thank you for holding this hearing on a subject so important to not only the people in and around Plymouth area, but certainly to all the people of Massachusetts.

You've asked for me this evening to speak about the demand for Pilgrim's power in meeting Massachusetts' and New England's energy situation. While the current supply in the Commonwealth of Massachusetts of energy is tight, it is not so tight that the public health and safety need be placed at risk with the operation of any given power plants, including the Pilgrim nuclear power plant.

New analyses prepared by the New England Governors' Conference and the New England Energy Policy have indicated that New England's power needs can be met with existing and planned resources and potential new resources combined with effective management. These analyses have provided evidence that Pilgrim will not make or break the electricity supply of New England.

In Massachusetts, State and utility officials are working to assure that power will be available when needed and at a reasonable cost, both over the short term and the long term.

Recent accomplishments of State and utility officials will improve the power supply of the region. For example, the enactment of the State appliance efficiency standards last year; a more efficient building code, so that the buildings we construct in Massachusetts could be ones that could use energy efficiently. The establishment of a cogeneration of small power bidding and development process, and the approval by the Energy Facility Siting Council, of which I chaired a couple of weeks ago, of a 300 megawatt gas unit in Bellingham, MA. These will make substantial contributions to the Massachusetts electricity need.

In addition, current projects will enhance future power planning and supply. For example, State officials have requested utilities to increase their capabilities to manage load requirements at the time of peak demand. The State is also investing ways to fully develop conservation, load management and cogeneration at State facilities. Furthermore, the Executive Office of Energy Resource and others are working with the Department of Public Utilities to establish least-cost planning process, which will significantly enhance the development of cost effective, socially beneficial electric resources in Massachusetts.

What I would also like to note is that Pilgrim's past operating performance indicates that it cannot necessarily be relied upon to provide the power that we need. Pilgrim's lifetime operating performance is worse than roughly 80 percent of all the other nuclear power plants in the country. In the past, Pilgrim has been available to produce electricity less than half of the time that it was needed.

In addition, there is not a strong need to operate Pilgrim for economic reasons. While there are many uncertainties as to the economics of future power supplies, a recent analysis indicates that Pilgrim may not necessarily provide any economic savings to ratepayers if it operates.

Therefore, I would like to make it clear that while peak electricity resources are currently tight, there is no compelling need to op-

erate Pilgrim for power supply or economic purposes if it poses an unacceptable risk to the health and safety of the people of Massachusetts.

As was indicated by my colleagues from the administration, Governor Dukakis has not yet made a determination as to the ultimate role which he believes Pilgrim should play, if any. The determination will be made only after the issues of plant management, containment integrity and evacuation plan adequacy have been resolved. Thank you very much, Senator.

The CHAIRMAN. Thank you very much. Dr. Prothrow-Stith.

Dr. PROTHROW-STITH. Good evening, Senator. Let me start by adding my thanks to you for this opportunity. I represent Secretary Johnston of the Executive Office of Human Services and the Department of Public Health as its commissioner.

We take seriously our responsibilities for the health of the citizens of Massachusetts, and with regard to the Pilgrim plant we have two responsibilities. One has to do with monitoring radiation exposure, and the other one has to do with investigation of disease outbreaks.

Relative to monitoring, we are the primary State agency responsible for radiation control. We have conducted radiation monitoring activities in the vicinity of the plant since the mid 1970's. These activities include: one, a network of monitoring stations; two, periodic surveys to determine the extent and seriousness of radiation dosage received by humans and animals; and, three, periodic inspections of the power plants itself.

Our monitoring of radiation includes the dosimeters located at 46 sites to measure radiation. They are tested quarterly and would indicate any unusual exposure to radiation among the population within 5 miles of the reactor. We also monitor airborne radiation at the plant. Water, milk, food, fish, and sediment samples are also tested regularly. We conduct weekly inspections of the Pilgrim plant, checking internal monitoring and safety protocol. In the event of an accident, we would be responsible for a dose assessment and for recommendations of appropriate protective actions.

The department wants to establish a state of the art comprehensive monitoring program in the vicinity of Pilgrim that could serve as an early notification system and insure prompt emergency response in the event of any releases of radioactivity that might present a threat to the public health and safety, and also to insure adequate monitoring points to measure radiation in the vicinity of the reactor.

The department wants a real time monitoring system which would involve the transmission to a State facility of ongoing radiation levels at selected locations both within the boundaries and offsite of the nuclear powerplants. This system, similar to one in place in Illinois, would allow the department to know instantaneously when radiation was released into the environment. In addition, an on-line data communication link to the state's facilities computer would be included in this system. This would allow us to know the status of the reactor, that is, the temperature, the pressure, the water level, et cetera, on a real time basis, as well as further provide early notification of events that could lead to nuclear

accidents. We believe that this improved monitoring is an important part of a safe evacuation plan.

Our second responsibility is the investigation of disease outbreaks.

The CHAIRMAN. Let me ask you about that monitoring program. That is going to cost something, I imagine?

Dr. PROTHROW-STITH. It will cost something.

The CHAIRMAN. Is that going to be a priority for the state or are you going to the Federal Government or what?

Dr. PROTHROW-STITH. This is something that at this point, we are proposing; it has been proposed in the past and we are in the very early stages of a more recent proposal.

The CHAIRMAN. Does Illinois pay for it out of State funds or do they get some Federal funding, do you know?

Dr. PROTHROW-STITH. I'm not sure.

The CHAIRMAN. OK. Well, if you might let us know on that. If it is done with the States' funds, obviously we'll welcome that. If you feel you have to come to the Federal Government, I'll be glad to submit——

Dr. PROTHROW-STITH. An offer that we would appreciate. [Laughter.]

The CHAIRMAN. We'll stop right now, and I'll ask you to stand, if you would. [Laughter.]

Listen carefully.

[Witnesses sworn.]

Do you solemnly swear that the testimony you have given and will continue to give will be the truth, the whole truth, and nothing but the truth, so help you God?

The CHAIRMAN. Three years of law school. Well, that is a serious matter. As you mentioned, the work that is done in Illinois appears to be important and significant, and we'd like to know how it is going to proceed and hope you keep in touch.

Dr. PROTHROW-STITH. We would like to do that.

Relative to the investigation of disease outbreaks that might be caused by contamination in the environment, we are currently conducting a study in the Plymouth area into the causes of elevated rates of leukemia, a type of cancer that is shown to be caused by ionizing radiation.

We concluded an assessment of the 1982 to 1985 health related data for the area around the plant in order to determine the health of South Shore residents and how that might be affected by the Pilgrim reactor. That assessment showed no unusual statistical trends in the patterns of death from cancer or in the frequency of infant mortality. Some anomalies in infant mortality and low birth rates had been reported. The numbers are so small that it's impossible to draw any statistically valid conclusion.

We did find, however, a statistically significant excess in the incidents of leukemia among males in the five coastal communities surveyed. These elevations are specifically among the types of leukemia that can be caused by exposure to radiation.

The incidents of leukemia among females was also elevated, but not to the same significant degree. The group should question, of course, whether Pilgrim is responsible for the high incidents of leukemia. At present it is impossible to answer that question, but the

Department of Public Health is currently conducting two separate investigations that may bring us closer to the answer.

First, we are conducting a case-control epidemiological study to help us identify the possible causes of the excess leukemia. In the course of this study, we will interview all leukemia cases diagnosed since 1982, or their families, in the communities of Plymouth, Kingston, Duxbury, Marshfield, and Scituate. We'll take data on the places of residence, occupation and medical histories. This information will be compared with similar data from people without leukemia from the same communities in order to look for any differences. This study will help determine any association between leukemia and possible other sources of exposure, such as Benzene, chemotherapy, et cetera.

We must be very frank about the limitations of this study. Epidemiology has its limits, especially in cases where we are dealing with small populations, relatively small number of cases, small doses and small levels of exposure, but if we don't look, we won't learn anything at all.

Second, we're looking into the possibilities that a coastal wind pattern may have contributed to the dispersion of radiation emission from Pilgrim in a way that bypassed existing radiation monitoring. This work, being conducted through a contract at the Harvard School of Public Health, will determine the feasibility of estimating the level of radiation reaching the general population. This study is up and running and should be completed within the next couple of months in its initial phase.

It is our objective that the combined results of these investigations will permit an informed estimate of the contributions of Pilgrim emissions to the elevated incidence of leukemia in the vicinity of Pilgrim. We would like to work with Dr. Winegarten, if, in fact, NIH is very interested in doing some work here. We would be excited about that opportunity.

In summary, we are interested in increasing our monitoring capabilities so that you have state of the art capability, and also we are very interested in continuing these studies, but as well, participating with NIH if that opportunity is available. Thank you very much.

[The prepared statement of Dr. Prothrow-Stith follows:]

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TESTIMONY OF DEBORAH PROTHROW-STITH, M.D.
COMMISSIONER, DEPARTMENT OF PUBLIC HEALTH
JANUARY 7, 1988

GOOD EVENING MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE. MY NAME IS DEBORAH PROTHROW-STITH AND I AM COMMISSIONER OF THE DEPARTMENT OF PUBLIC HEALTH.

THE MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH HAS A TWO-FOLD RESPONSIBILITY WITH RESPECT TO THE OPERATIONS OF THE PILGRIM NUCLEAR POWER PLANT, MONITORING RADIATION EXPOSURE AND INVESTIGATING DISEASE OUTBREAKS.

-FIRST, WE ARE THE PRIMARY STATE AGENCY RESPONSIBLE FOR RADIATION CONTROL. WE HAVE CONDUCTED EXTENSIVE RADIATION MONITORING ACTIVITIES IN THE VICINITY OF THE PLANT SINCE THE MID-1970s. THESE ACTIVITIES INCLUDE A NETWORK OF MONITORING STATIONS, PERIODIC SURVEYS TO DETERMINE THE EXTENT AND SERIOUSNESS OF RADIATION DOSES RECEIVED BY HUMANS AND ANIMALS AND PERIODIC INSPECTIONS OF THE POWER PLANT ITSELF.

OUR MONITORING OF RADIATION INCLUDES DOSIMETERS LOCATED AT 46 SITES TO MEASURE GAMMA RADIATION, THE TYPE OF RADIATION WE WOULD FIND. THESE DOSIMETERS ARE CHECKED QUARTERLY, AND THEY WOULD INDICATE ANY UNUSUAL EXPOSURE TO GAMMA RADIATION AMONG THE POPULATION WITHIN FIVE MILES OF THE REACTOR.

THROUGH A COOPERATIVE AGREEMENT WITH THE NUCLEAR REGULATORY COMMISSION, WE CONTINUALLY MONITOR AIRBORNE RADIATION AT THE PLANT. WATER, MILK, FOOD, FISH, AND SEDIMENT SAMPLES ARE TESTED REGULARLY. WE ALSO CONDUCT WEEKLY INSPECTIONS OF THE PILGRIM PLANT, CHECKING INTERNAL MONITORING AND SAFETY PROTOCOLS.

IN THE EVENT OF AN ACCIDENT, THE DEPARTMENT OF PUBLIC HEALTH WOULD BE RESPONSIBLE FOR DOSE ASSESSMENT AND FOR RECOMMENDING APPROPRIATE PROTECTIVE ACTIONS.

THE DEPARTMENT WANTS TO ESTABLISH A STATE OF THE ART COMPREHENSIVE MONITORING PROGRAM IN THE VICINITY OF PILGRIM THAT COULD SERVE AS AN EARLY NOTIFICATION SYSTEM AND INSURE PROMPT EMERGENCY RESPONSE IN THE EVENT OF ANY RELEASES OF RADIOACTIVITY THAT MIGHT PRESENT A THREAT TO

PUBLIC HEALTH AND SAFETY AND ALSO TO INSURE ADEQUATE MONITORING POINTS TO MEASURE RADIATION IN THE VICINITY OF THE REACTOR.

THE DEPARTMENT ALSO WANTS A REAL TIME MONITORING SYSTEM WHICH WOULD INVOLVE THE TRANSMISSION TO A STATE FACILITY OF ONGOING RADIATION LEVELS AT SELECTED LOCATIONS BOTH WITHIN THE BOUNDARIES AND OFF-SITE OF NUCLEAR POWER PLANTS. THIS SYSTEM WOULD ALLOW THE DEPARTMENT TO KNOW INSTANTANEOUSLY WHEN RADIATION WAS RELEASED INTO THE ENVIRONMENT. IN ADDITION, AN ON-LINE REACTOR PARAMETER DATA COMMUNICATION LINK TO THE STATE FACILITY'S COMPUTER WOULD BE INCLUDED IN THIS SYSTEM. THIS WOULD ALLOW US TO KNOW THE STATUS OF A REACTOR, i.e. TEMPERATURE, PRESSURE, WATER LEVEL, etc. ON A REAL TIME BASIS, AS WELL AS FURTHER PROVIDE EARLY NOTIFICATION OF EVENTS THAT COULD LEAD TO NUCLEAR ACCIDENTS.

- SECOND, WE ARE RESPONSIBLE FOR INVESTIGATING DISEASE OUTBREAKS IN THE COMMONWEALTH, INCLUDING THOSE THAT MAY BE CAUSED BY CONTAMINATION IN THE ENVIRONMENT. WE ARE CURRENTLY CONDUCTING A STUDY IN THE PLYMOUTH AREA INTO THE CAUSES OF ELEVATED RATES OF LEUKEMIA, A TYPE OF CANCER THAT CAN BE CAUSED BY EXPOSURE TO IONIZING RADIATION.

TEN MONTHS AGO, THE DEPARTMENT CONCLUDED AN ASSESSMENT OF ALL HEALTH RELATED DATA FOR THE AREA AROUND THE PLANT IN ORDER TO DETERMINE WHETHER THE HEALTH OF SOUTH SHORE RESIDENTS MIGHT BE AFFECTED BY THE PILGRIM REACTOR.

THAT ASSESSMENT SHOWED NO UNUSUAL STATISTICAL TRENDS IN THE PATTERN OF CANCER DEATHS OR IN THE FREQUENCY OF INFANT MORTALITY OR LOW-BIRTHWEIGHT. WHILE SOME ANOMALIES IN INFANT MORTALITY AND LOW BIRTHWEIGHT HAVE BEEN REPORTED, THE NUMBERS ARE SO SMALL THAT IT IS IMPOSSIBLE TO DRAW ANY STATISTICALLY VALID CONCLUSIONS. WE DID FIND A STATISTICALLY SIGNIFICANT EXCESS IN THE INCIDENCE OF CANCERS OF THE BLOOD-FORMING ORGANS AMONG MALES IN THE FIVE COASTAL COMMUNITIES SURVEYED. THESE ELEVATIONS ARE AMONG THE TYPES OF LEUKEMIA THAT CAN BE CAUSED BY EXPOSURE TO RADIATION. THE INCIDENCE OF LEUKEMIA AMONG FEMALES WAS ALSO ELEVATED, THOUGH NOT TO THE SAME SIGNIFICANT DEGREE.

THE CRUCIAL QUESTION, OF COURSE, IS WHETHER PILGRIM IS RESPONSIBLE FOR THE HIGH RATE OF LEUKEMIA. AT PRESENT, IT IS IMPOSSIBLE TO ANSWER THAT QUESTION UNEQUIVOCALLY, BUT THE DEPARTMENT OF PUBLIC HEALTH IS CURRENTLY CONDUCTING TWO

SEPARATE INVESTIGATIONS THAT MAY BRING US CLOSER TO THE ANSWER.

FIRST, WE ARE CONDUCTING A CASE-CONTROL EPIDEMIOLOGIC STUDY TO HELP US IDENTIFY THE POSSIBLE CAUSES OF THE EXCESS LEUKEMIA.

IN THE COURSE OF THIS STUDY, WE WILL INTERVIEW ALL LEUKEMIA CASES DIAGNOSED SINCE 1982, OR THEIR FAMILIES, IN THE COMMUNITIES OF PLYMOUTH, KINGSTON, DUXBURY, MARSHFIELD AND SCITUATE. WE WILL TAKE DATA ON THEIR PLACES OF RESIDENCE, OCCUPATION, AND MEDICAL HISTORIES. THIS INFORMATION WILL BE COMPARED WITH SIMILAR DATA FROM PEOPLE WITHOUT LEUKEMIA FROM THE SAME COMMUNITIES IN ORDER TO LOOK FOR ANY DIFFERENCES. THIS STUDY WILL HELP DETERMINE ASSOCIATIONS BETWEEN LEUKEMIA AND POSSIBLE SOURCES OF EXPOSURE SUCH AS CHEMOTHERAPY AND/OR RADIATION THERAPY.

WE MUST BE VERY FRANK ABOUT THE LIMITATIONS OF THIS STUDY. EPIDEMIOLOGY HAS ITS LIMITS, ESPECIALLY IN CASES SUCH AS THIS WHEN WE ARE DEALING WITH SMALL POPULATIONS, RELATIVELY SMALL NUMBERS OF CASES, SMALL DOSES, AND SMALL LEVELS

OF EXPOSURE. BUT IF WE DON'T LOOK, WE WON'T LEARN ANYTHING AT ALL.

SECOND, WE ARE LOOKING INTO THE POSSIBILITY THAT COASTAL WIND PATTERNS MAY HAVE CONTRIBUTED TO THE DISPERSION OF RADIATION EMISSIONS FROM PILGRIM IN A WAY THAT BYPASSED EXISTING RADIATION MONITORING. THIS WORK, BEING CONDUCTED THROUGH A CONTRACT WITH THE HARVARD SCHOOL OF PUBLIC HEALTH, WILL DETERMINE THE FEASIBILITY OF ESTIMATING THE LEVEL OF RADIATION REACHING THE GENERAL POPULATION.

IT IS OUR OBJECTIVE THAT THE COMBINED RESULTS OF THESE INVESTIGATIONS WILL PERMIT AN INFORMED ESTIMATE OF THE CONTRIBUTION OF PILGRIM EMISSIONS TO THE ELEVATED INCIDENCE OF LEUKEMIA IN THE VICINITY OF PILGRIM.

The CHAIRMAN. Thank you very much, Doctor. We appreciate your testimony and your comments.

Let's move to Ms. Pollard. I know that we're relying to some degree on HydroQuebec; is that correct.

Ms. POLLARD. We are receiving—3 percent of the electricity we use in New England is imported from Canada, so right now it is a very small percentage. It increases to about 10 percent by the year 1991. About 10 percent of all the electricity that we use is not considered excessive. However, any additional import of electricity beyond that would have to be looked at that for that reason. we know from past experience that——

The CHAIRMAN. Someone mentioned to me, earlier today, about the possibility of importing energy from the midwest.

Ms. POLLARD. Yes.

The CHAIRMAN. I'm unfamiliar with both possibilities, the realities and the difficulties.

Ms. POLLARD. Very briefly, the governors of New England have spoken with some of the Governors in the Midwest that have some coal resources within their States. It would work this way. That New England ratepayers would bill powerplants in the Midwest, that New England ratepayers would put on those powerplants the best available control technology to help with our acid rain situation.

It is thought that that energy would still be reasonable in terms of the cost to the ratepayers. So there is some thought that you get double win from this. That your access is reasonable energy prices and that you are also helping with the acid rain situation. There is only one problem. You would have to put a transmission line through the State of Pennsylvania and through the State of New York, and there is some concern that those two States might not be thrilled about the idea.

The CHAIRMAN. Let's keep moving on. I'd like to know more about it. We'll inquire. You are probably aware of the Department of Energy comparing the record of powerplants nationwide, and the Department of Energy rated New England 23 out of 26 in its ability to keep its plants open from 1983 to 1985. I wonder if you are familiar with those findings, and if so——

Ms. POLLARD. We are.

The CHAIRMAN [continuing]. What you concluded.

Ms. POLLARD. The Federal Department of Energy has conducted that history. We are obviously not pleased with the evidence and the information that was presented in that report. We have our powerplants not maintained as well as other powerplants in other parts of the country; our have a tendency to be down at a more frequent rate than in other parts of the country. And we believe that part of the problem this past summer was just precisely that. When you have one-third of your available electricity down and unable to be used, that's what causes you some concern and it may cause you some problem.

We have continued—have in the past, and will continue to encourage the utilities to maintain their plants well and to schedule their maintenance at times of the year when we are not experiencing the greatest demand for electric.

The CHAIRMAN. What is the single most important criterion for judging whether or not the Pilgrim plant should be operational?

Ms. POLLARD. The health and safety of the people who live within the radius of this power plant and that is the most important criteria that the Governor will consider.

The CHAIRMAN. Doctor, let me ask you how you respond to some of the criticism you heard earlier levied against the Department concerning its interaction with residents of the local area as well as statewide? We know you just recently become the Commissioner with responsibilities concerning these difficulties which allegedly had existed earlier, but I imagine you had heard of them and were concerned about them, and I'm just wondering what kind of reassurance you might be able to give people in the area, and the way you might perceive situations?

Dr. PROTHROW-STITH. I think it's important to say that we are committed to the health, and the protection of the health, of the citizens of the Commonwealth, and as a new commissioner in the Department of Public Health, that commitment is something that I feel very comfortable reaffirming.

It is important to say that I think part of the history of the problem that we have had has been a situation where some promises were made that were not able to be met and perhaps mistakes were made. I don't know the details of those histories, but I would say very clearly to the citizens here tonight that the commitment is strong at the Department of Public Health and we intend not only to complete these studies, but to work with the community, as we have continued to do in the last few months, in order to make sure that the health and safety concerns are addressed.

The CHAIRMAN. Well, I think from what I have known of you, the people in this area would have a good sense of your appreciation for those concerns and your commitment because I know it will be carried forward.

I think you talked about our request for a study by the NIH. You might be helpful to us who are working with the NIH, in terms of assistance in the development of that study. I would ask you to do that at some time.

Dr. PROTHROW-STITH. What I would like to do, perhaps, is to forward to you some of the information that—in a cover letter, that I could send Dr. Winegarten offering what we currently know in our participation.

The CHAIRMAN. A final point. Boston Edison has been identified as having a higher rate of worker exposure. Does the Department of Public Health have the option of conducting a study of worker exposure or is this something that is referred to OSHA.

Dr. PROTHROW-STITH. The Department of Labor has that responsibility. Edison and the Department of Labor are looking into that issue. We would encourage that more be done. It is important, and I think the NIH participation may help us with this, to look at national data and some international data, as well as worker data, as a way to fully appreciate the health risks. So I would encourage that more be done, and if we can help in any way, though it is not our direct responsibility, we would be willing to do that.

The CHAIRMAN. I want to thank the panel. We had a chance to see your full testimony and you covered many additional areas

which we were interested in. I think this panel has helped us to understand better the problems of emergency planning, energy supplies, and the public health concerns. We value very much all of your testimony. It has been very, very helpful. I know now where to go for additional information, so we are grateful to all of you.

Dr. PROTHROW-STITH. Senator, may I say one other thing. I just learned that the utilities pay for the monitoring system in Illinois.

The CHAIRMAN. I wonder where that little bit of information came from. [Laughter.]

We have a final panel. We want to give them some attention. We're going to proceed to that panel. We have been in session for three hours. I want you to know this is a very important panel. We put great emphasis on it. I would like to have about a 10-minute recess, and then we're going to stay here as long as it takes to run through the last panel. We want to give them our attention. We have important questions, but we want to take our time with that panel. They deserve attention.

You have been a very attentive audience. This has been a very informative hearing. We have collected a great deal of information and we're grateful to all of those who participated and helped us, but since we have been in here for this period of time, we will have a 10-minute recess. I know some people have to leave. We're grateful to them for their presence, but I would hope as many as possible would stay. I think this will be an informative session with the last panel.

[Ten-minute recess.]

The CHAIRMAN. I ask that everybody rejoin us and take their seats so we can give our full attention to the final panel. Again, you've very attentive. We'll ask that people be kind enough to take their seats.

First of all, we want to thank Nadine O'Neill, and I'm going to ask all of you if you will join in giving our wonderful interpreter a hand this evening.

[Applause.]

The CHAIRMAN. She's doing a magnificent job.

I shall ask our panelists if they will be kind enough to raise their hands and do say if——

[Witnesses sworn.]

The CHAIRMAN. We have a few housekeeping details, we have statements from some of our colleagues, Representative Studds, and Senator Kerry, and we will include their statements in the record. I'll indicate to those whose testimony we have not been able to receive in person, given the time that's been available to us, we'll be glad to receive that testimony. I know that it won't be considered as sworn testimony, but nonetheless, it will be valuable to us if it is informational, and we will instruct the staff to make that part of the testimony which is relevant to this hearing a part of the record and we'll leave the record open to the time that the Congress comes back in, later in this month. So if there are those who have opinions or who have views or who would take differing views from what we have heard this evening, who would like to be part of the record, they shall be.

[The statements referred to above follow:]

STATEMENT OF
THE HONORABLE GERRY E. STUDDS
BEFORE THE
SENATE COMMITTEE ON LABOR AND HUMAN RESOURCES
January 7, 1988

I first want to commend Senator Kennedy for holding today's hearing, which will focus on health matters related to the reopening of Pilgrim Nuclear Power Station and the associated issue of emergency evacuation planning. I have received dozens of letters from constituents about the plant, and it is clear that these issues are of paramount concern.

The Pilgrim plant has been shut down since April 1986 because of serious questions about safety and management. The Nuclear Regulatory Commission's (NRC) most recent evaluation found the facility's performance in five significant areas to be minimally satisfactory. In addition, the Federal Emergency Management Agency (FEMA) has concluded that existing emergency evacuation plans are inadequate to protect the public and could not be implemented until deficiencies were corrected. State and local emergency planning officials are working with Boston Edison to revise these plans, but this task will not be completed for several more months.

Boston Edison officials have indicated that modifications to the plant should be completed by the end of January, and they are expected to ask the NRC for restart approval soon after. The agency will then have a very important decision to make.

This determination will be made in the context of an evolving national policy on emergency planning. The critical need for state and local government preparedness became obvious in the aftermath of the 1979 accident at Three Mile Island. Congress responded by directing the NRC to deny a nuclear reactor operating license unless there was reasonable assurance that adequate protective measures would be taken in the event of an emergency. This past October, in an action with potential local implications, the NRC issued a rule significantly weakening the requirement for state and local participation in emergency planning.

It is my view that the NRC would be ignoring its Congressional mandate and would be making a grievous mistake if it allowed Pilgrim to resume operations before an evacuation plan, acceptable to state and local officials, is developed. The NRC commissioners cannot allow Pilgrim to reopen with a simple statement that they are satisfied with the progress of emergency planning. The citizens of Plymouth and the surrounding area must be confident that when the plant's turbines start to turn, their local officials will be able to protect their health and safety in the event of an accident. Unless there is an approved plan in place, they will not have such an assurance.

If an accident occurs, local emergency planning personnel must be able to follow procedures that have been thoroughly and completely discussed, reviewed and practiced. Evacuation planning activities, by their very nature, cannot be carried out without the close involvement of community officials. Timely warning, effective traffic control, evacuation assistance for special populations such as schoolchildren, nursing home residents, or the disabled -- all these are essential tasks that are uniquely and obviously the responsibility of local government.

If the Plymouth plant had a longstanding history of competent management and a flawless operating record, perhaps the details of emergency planning would not be so crucial. But Pilgrim, characterized by many years of mismanagement and numerous regulatory violations, demands full attention to this aspect of its operation.

I want to join other Massachusetts officials in once again stating, loudly and clearly, that Pilgrim Nuclear Power Station should not be allowed to reopen unless and until all emergency planning, management and safety issues have been satisfactorily addressed.

STATEMENT OF SENATOR JOHN F. KERRY BEFORE THE SENATE LABOR AND HUMAN RESOURCES COMMITTEE

January 7, 1988

Mr. Chairman, I would like to thank you and the other members of the Senate Labor and Human Resources Committee for conducting this important hearing tonight. Many of us in Massachusetts have been extremely concerned about the safety of this plant and the health effects on the surrounding communities around Pilgrim, and this hearing will play an important role in the investigation into this problem.

It is especially important that the Chairman has chosen to conduct this hearing, in light of the U.S. Nuclear Regulatory Commission's continued refusal to open formal public hearings on the reopening of this plant. Since September, Senator Kennedy, Congressman Studds, I and various elected officials across the state have requested formal hearings from the N.R.C. on the reopening of this plant, to give those who live near this plant an opportunity to have their questions answered and their concerns raised. Once again, in refusing to conduct these hearings, the N.R.C. has not fulfilled its regulatory responsibility, and the Chairman has provided a valuable forum for these issues to be addressed.

The recent history of the Pilgrim Nuclear Power Plant is one of failure and neglect. Served with the largest penalty ever issued by the N.R.C, the plant was closed in April, 19[illegible] because of repeated failures of its emergency equipment and for chron[illegible] [illegible]nagement problems. The Boston Edison Company, for the past year and a half, has undertaken a management and

safety review and upgrade program to address these problems. They in recent months have reloaded fuel, and hope to have permission to restart the plant in the next few months. However, in November of 1987, the plant was again beset with safety and health problems, as contaminated water exposed workers to radioactive contamination and offsite generator power problems occurred, which could have had grave consequences were the plant on line at the time.

There are two fundamental questions that must be addressed before this is plant should be allowed to restart: 1) are the evacuation plans for the communities surrounding this plant adequate, regardless of safety improvements that have been made on-site, and 2) is the Nuclear Regulatory Commission in the best position to determine whether everything that can be done, has in fact been done to improve safety at the plant?

First, it is my belief that the issue of adequate evacuation plans for the communities within a ten mile radius of the plant is still outstanding, and that no decision to restart the plant should be made until this issue has been fully resolved. Not only have various community civil defense committies found serious flaws in the plans that Boston Edison has on file, but the Commonwealth of Massachusetts has also recently determined that these plans are not viable in their current state. Unfortunately, the N.R.C., in a recent rule change, has eliminated the state's role in determining the adequacy of evacuation plans, and will allow those plans that have not met state criteria to be approved by the N.R.C. Although the Pilgrim Plant went on line before the accident at Three Mile Island, and therefore was not required to have approved evacuation plans before being granted an operating license, the issue of adequate evacuation plans in the event of an

accident is no less critical. I strongly opposed the N.R.C. rule change, and will continue to fight in Congress for the state's role in determining the adequacy of evacuation plans.

I am also seriously concerned about the N.R.C.'s ability to determine if this plant is safe to return to operation. The role of the U.S. N.R.C. as a regulator of the nuclear industry has come under close scrutiny in Congress recently, and has led to some disturbing conclusions about the Commission. An Investigative Report issued in December, 1987 by the House Subcommittee on General Oversight and Investigations concludes that the N.R.C. has failed to maintain an arms length relationship with the industry, stating that "Over the past several years, the Nuclear Regulatory Commission has demonstrated an unhealthy empathy for the needs of the nuclear industry to the detrime[illegible] of the safety of the American people." (p. 41). One of the most seriou[illegible] raised by the report is the so-called "backfit rule", which has allowed the N.R.C. to evaluate safety improvements to plants already in operation against the cost to the utility to implement them. In 1986, under the first full year under this rule, the N.R.C. did not impose a single plant-specific backfit, and it required only one industry-wide backfit which cost utilities less than $8,000 per plant. In opposition to the adoption of this rule, former N.R.C. Commissioner James Asselstine concluded, "The consequence of this rule is to limit the NRC staff's and even the Commission's ability to identify and correct safety weaknesses at the nuclear power plants in operation and under construction in this country." This rule was struck down last August by the U.S. Court of Appeals in D.C., and the N.R.C. issued a new proposed rule which eliminates the cost/benefit analysis for those improvements necessary for "adequate protection." However, this new rule does little to address the problem of vagueness cited by the Court because it still does not define "adequate protection," allowing the staff to determine that all safety improvements exceed the adequate protection level and therefore can be evaluated in terms of cost to the utility.

The issue of the N.R.C.'s coziness with the nuclear industry causes serious concern with regard to the Pilgrim Plant. The N.R.C. to date has not issued any guidelines in determining whether sufficient safety improvements have been made at the plant to allow it to restart. Further, in light of the Commission's record on requiring safety improvements to be made at any of the nation's nuclear plants, it is almost impossible to have confidence in their ability to determine whether sufficient steps have been taken. Finally, the N.R.C. has recently decided that, despite documented flaws in the design of the Mark I containment vessel employed at Pilgrim, they will determine whether Pilgrim should go back on-line without taking into account the problem with the containment vessel. All of these decisions by the N.R.C. indicate that the public can have little faith in the decision that the Commission makes with regard to the Pilgrim Plant.

For the past two years, because of my concerns over both the Seabrook and Pilgrim Nuclear Power plants, I and my colleagues in the Massachusetts delegation have sought to bring greater accountability to the Nuclear Regulatory Commission. The N.R.C.'s unwillingness to heed the advice of the states regarding adequate evacuation plans, and their neglect of needed safety improvements at plants currently in operation, have caused serious concern in Congress. I will continue to use every opportunity to improve the public accountability of the N.R.C., and again, I thank Mr. Chairman for conducting these important hearings on this issue. I know that the testimony presented tonight from residents, state officials, and the N.R.C. will add greatly to the debate in Congress, and I look forward to reading the testimony presented here tonight.

(Appendix A)

HEALTH SURVEILLANCE OF THE PLYMOUTH AREA

Massachusetts Department of Public Health
Center for Health Promotion and
Environmental Disease Prevention

March 16, 1987

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EXECUTIVE SUMMARY

Analyses of health data have been carried out to examine whether there is excess risk of certain adverse health outcomes among residents in the vicinity of the Pilgrim Nuclear Facility located in Plymouth. Five communities were studied because of their proximity to the Pilgrim Plant, area topography, and coastal meteorological conditions. These communities were Duxbury, Kingston, Marshfield, Plymouth, and Scituate. The data revealed no disturbing trends in either the patterns of cancer mortality or in the expression of low birthweight and infant mortality. Radiation monitoring records do not suggest any significant levels of radiation off-site of the Pilgrim plant (the levels of radiation residents of the surrounding communities are potentially exposed to). However, a statistically significant increase in the incidence of cancers of the blood forming organs, primarily leukemia, among males in the five coastal towns has been identified. The number of leukemia cases diagnosed among female residents of the five towns were also higher than expected.

This descriptive study, as the first step of an epidemiologic investigation, has identified the existence of an apparent excess risk of cancer of the blood forming organs, particularly leukemia, among the residents of the five towns. Major gaps exist in our present understanding of the relationship between the occurrence of leukemia and the Pilgrim Nuclear Facility. The second step of an epidemiologic investigation is to determine the likely cause(s) of the excess risk. This data can only be reliably obtained from the cases themselves. Additional resources would be required to collect this detailed information.

This report presents a review of the health and environmental data for the Plymouth area. The data were collected in response to citizen concerns over possible health impacts from the operation of the Pilgrim Nuclear Facility.

SCOPE OF THE PROBLEM

Three analyses have thus far been initiated by the Massachusetts Department of Public Health (MDPH) to examine whether there is an unusual occurrence of selected adverse health outcomes among the residents of five towns - Duxbury, Kingston, Marshfield, Plymouth, and Scituate. These communities were chosen because of their proximity to the Pilgrim Plant, area topography, and coastal meteorological conditions.

Since the basic question related to the possible health effects from ionizing radiation, the kind of radiation associated with x-rays and radioactivity, two of our analyses focused on radiation induced cancers. These cancers are leukemia, multiple myeloma, and cancers of the breast and thyroid. The third analysis focused on adverse reproductive outcomes. All of these health outcomes were chosen because of their known or suspected relationship with exposure to low-dose ionizing radiation, as reported in current medical literature. Information on these health outcomes is routinely collected by MDPH.

Mortality Data

The first analysis reviewed mortality from leukemia and cancers of the breast and thyroid during the period 1969 through 1983. The numbers of

deaths were determined for the five towns, as well as for Plymouth County. The observed numbers of deaths in the five towns were compared to the numbers expected based upon state mortality rates adjusted for age and population differences.

Very few thyroid cancer deaths occurred in the five towns and so no conclusions could be drawn from that data. Tables 1 and 2 show mortality from breast cancer (table 1) and leukemia (table 2) among the residents of Plymouth, the five coastal towns combined (Duxbury, Kingston, Marshfield, Plymouth, and Scituate), and the remaining Plymouth County towns. These data are given for two time periods, 1969-73 and 1979-83. These are the years for which complete data on expected numbers of deaths in the five towns are currently available. The first time period, 1969-73, essentially represents the period before Pilgrim became operational. In both time periods, there was a slightly higher number of breast cancer deaths observed in the five towns than expected (table 1), but these differences were small and statistically not significant. The observed mortality from leukemia in both time periods was also slightly greater than the expected number among the female population, particularly in the town of Plymouth and the five coastal towns combined. Similar excess in leukemia mortality was observed among male residents of the town of Plymouth, but only during 1969-73. However, all these differences between observed and expected mortality were small and statistically not significant. Most importantly, the ratios of observed to expected numbers of leukemia deaths are similar in both time periods. The ratios would be expected to be greater in the later time period if suspected emissions from Pilgrim were resulting in increased cancer mortality. Overall, it appears that compared to the residents of Massachusetts as a whole,

individuals living in the five towns probably did not experience excessive mortality from these cancers.

Appendix I shows the numbers of observed and expected deaths from leukemia among the residents of all towns within approximately twenty miles of the Pilgrim Facility during the two time periods. This data is presented to illustrate the number of deaths for each town in the region. These towns represent a large geographic area where the potential for exposure to emissions from a point source such as Pilgrim would differ greatly among the residents. Therefore, an analysis of the area as a whole to explore any possible relationship with Pilgrim emissions would be inappropriate.

Incidence Data

Cancer incidence, newly diagnosed cases, was reviewed in the second analysis. Incidence data were obtained from the Massachusetts Cancer Registry, which has collected information on all cancers diagnosed in Massachusetts since 1982. Computerized data were available for the years 1982-84 and all cases diagnosed in those years were used in this analysis. As in the first analysis, the numbers of observed cases were compared with the corresponding numbers of expected cases. Cancer incidence rates for the whole of Massachusetts were used to estimate the expected numbers.

There was no statistically significant excess of breast or thyroid cancer incidence among the residents of Plymouth or of the five towns combined. It should be noted, however, that an excess would not be expected from 1982-84 incidence data even if there was sufficient exposure from radiation to cause cancer. This is because it is estimated that these two

cancers take approximately fifteen years to develop after they are initiated by some causal factor like radiation. By 1984, the most recent year for which cancer incidence data is currently available, the Pilgrim Plant had been operational for less than twelve years. Therefore, it will be at least three years, and likely longer, before MDPH will have the cancer data to properly assess any possible relationship between Pilgrim emissions and breast and thyroid cancer.

Because of reporting practices of the Cancer Registry, all cancers of the hematopoietic and reticuloendothelial systems (cancers of the blood forming organs), which include leukemia as well as multiple myeloma and some very rare forms of cancer, were reviewed as part of the initial incidence analysis. Table 3 shows the incidence of cancers of the blood forming organs among the residents of Plymouth and the five coastal towns combined, diagnosed between 1982 and 1984. The apparent excess in observed incidence in Plymouth is statistically not significant. But when the cancers are reviewed for the five towns combined, the number of new cases diagnosed among males is significantly (statistically) greater than expected based upon state rates. The number of these cancers among females was also elevated, but the excess was not statistically significant.

Figures 1 and 2 show the distribution of hematopoietic and reticuloendothelial cancer incident cases (cancers of the blood forming organs) diagnosed in 1982 through 1984 in the five towns. They appear to be distributed throughout the census tracts within the towns.

As stated above, the cancers of the hematopoietic and reticuloendothelial system are comprised of several types of related cancers. The two

principal types are leukemia and multiple myeloma. Leukemia itself is characterized by several different subtypes. The major subtypes are chronic lymphocytic, acute lymphocytic, acute nonlymphocytic, and chronic myelogenous leukemias. Each of these cancer subtypes can be caused by certain environmental exposures. But, not all of the same environmental causes are related to each subtype of leukemia. For example, exposure to ionizing radiation does not appear to be associated with chronic lymphocytic leukemia (CLL) but is associated with the development of other types of leukemia and of multiple myeloma. With this in mind, the analysis of incidence was further focused to examine all hematopoietic and reticuloendothelial cancers, excluding CLL. Results were analyzed only for the five towns combined because of the small number of cases within each town.

Table 4a illustrates the results of this analysis for the five towns combined. The number of cases observed among males between 1982 and 1984 was again observed to be significantly (statistically) in excess over the number expected in the five towns. The number of female cases was also elevated but not statistically different from the number expected. In other words, there is a reasonable probability that the differences between observed and expected numbers among females are due to chance alone.

To further refine the analysis, the latency periods was reviewed for each of the cancer types and subtypes. Latency period is the length of time between initial exposure to the potential cause(s) of the cancer and the time when the cancer first becomes detectable (diagnosis). The latency of multiple myeloma is at least 15 years. The subtypes of leukemia have varying latent periods (2-20 years), frequently dependent upon age at

exposure. Since the latency of multiple myeloma is likely greater than the number of years Pilgrim has been operational, leukemia is the radiation-sensitive cancer outcome that would have the greatest probability of showing an association, using current cancer statistics, with any past Pilgrim emissions. Myelogenous leukemias are the leukemias most sensitive to induction by radiation.

Tables 4b through 4d show the number of observed and expected leukemias for this more refined analysis. Ten hospitals have been identified as the place of diagnosis for the 1982-84 leukemia cases. Four were in Boston and the remaining six hospitals represent the major health care centers in southeastern Massachusetts. Among males the incidence of each leukemia group was consistently elevated. Each elevation is statistically significant. The incidence of all leukemia and the subtype myelogenous leukemia among females was slightly elevated, but the numbers of observed cases were not statistically different from the number expected based upon state incidence figures.

One explanation for why the elevation is higher in males than females may be that males are at greater risk for exposure to the factor(s) that cause leukemia in the five towns. Epidemiologic research has shown that the induction of leukemia has been associated with a number of different factors, including chemicals, certain medical drugs, and diagnostic/therapeutic radiation. Occupational exposures that are known to cause leukemia, such as chemicals and radiation, are well-documented. It may be that males in the five towns had a greater opportunity for these occupational exposures, resulting in the higher elevations of leukemia. Another explanation may be that males had a greater potential for exposure to air emissions from Pilgrim because of the proximity to the

plant of their residence or place of employment. Without in depth knowledge of the type of work the cases performed, where they worked, and where they lived, it is not possible to determine the differences in potential for exposure between males and females to either occupational risk factors for leukemia or air emissions from Pilgrim.

Leukemia mortality was not significantly different from that expected, whereas leukemia incidence appears to be elevated, particularly among males. There are several possible explanations for these inconsistent findings.

One is that survival after the diagnosis of leukemia may be better in the five town area than in the state as a whole. This may be due to earlier diagnosis, better health care, or better utilization of health care facilities. With early diagnosis and treatment, an individual's cancer can frequently be controlled or cured. As a result, the individual may ultimately die from some cause unrelated to the cancer and thereby not be recorded as a cancer mortality statistic. Incidence would reflect all the cancers diagnosed but mortality, therefore, would reflect only those cancers for which the cause of death happened to be cancer.

Another explanation may be that the increase in the risk of leukemia is only recent and, therefore, would only be reflected in current incidence statistics. Most cancer deaths occur several years after diagnosis and so 1985 mortality would, for example, include many cases likely diagnosed before 1982. Incidence provides the best indication of current elevated risks of cancer.

A third explanation may be that the apparent elevation in leukemia

incidence is due to a chance fluctuation in the observed numbers. Numbers of observed cases characteristically increase and decrease from year to year. Therefore, these fluctuations are possibly unrelated to any general environmental exposures such as air pollution or contaminated drinking water. Small numbers, in particular, are frequently susceptible to significant fluctuations from year to year that can result in misleading differences when compared with expected numbers which are based on larger, more stable numbers.

Appendix II shows the numbers of incident cancers of the hematopoietic and reticuloendothelial system (cancers of the blood forming organs) in towns within twenty miles of the Pilgrim plant. As with the mortality data shown in Appendix I, it would be inappropriate to analyze these towns as a group because the potential for exposure to adverse environmental exposures would vary greatly from town to town.

Adverse Reproductive Outcomes

The third analysis dealt with two adverse reproductive outcomes in the Plymouth area, infant mortality and low birthweight. Adverse reproductive outcomes often are sensitive though nonspecific indicators of environmental problems. Figures 3 and 4 show annual infant mortality rates and prevalence of low birthweight among live births in the town of Plymouth, Plymouth County, and Massachusetts from 1969 to 1984. (Infant mortality is defined as death within the first year of life; and low birthweight is defined as birthweight below 2500 grams.) There was an obvious, gradual decline in both infant mortality and low birthweight rates in each of the three geographical areas before and after the Pilgrim plant was operational. The year-to-year fluctuations in the rates,

particularly for the town of Plymouth, show the susceptibility to variation of rates derived from very small numbers of events. For example, the 25 percent increase in infant mortality observed in the town of Plymouth from 1981 to 1982 is accounted for by an increase in the number of infant deaths from four to five. Without these short-term fluctuations, the rates for Plymouth Town and Plymouth County appear to have been lower than the rates for the State as a whole.

Environmental Data

In addition to health studies, MDPH has reviewed radiation data regarding the Pilgrim Nuclear Facility. Monitoring of ionizing radiation in the vicinity of the Pilgrim Facility has been ongoing since the plant first became operational in 1972. This monitoring is carried out by MDPH and the U.S. Nuclear Regulatory Commission (NRC), as well as Boston Edison. Measurements in the town of Plymouth have been compared with measurements from monitoring stations outside the Plymouth area, and suggest that radiation levels off-site around the Pilgrim plant have been at or below the levels measured elsewhere in the state.

Additionally, the U.S. Environmental Protection Agency (EPA) and the International Atomic Energy Agency (IAEA) have reported on background radiation levels for Massachusetts. Background radiation represents the amount of ionizing radiation that is normally present in the environment. The level for Massachusetts is reported as an average of approximately 13 microroentgens per hour. Except for one location on the Pilgrim site near the stack, radiation levels in Plymouth have essentially been at or below background levels for the state.

Additional environmental radiation data are currently under review by MDPH. These include radiation measurement data from lake sediment, pasteurized milk, and drinking water. Data from on-site radiation monitoring (particularly emissions at the stack), will also be reviewed to assess the levels of on-site radiation emissions over time.

PERSPECTIVE OF THE PROBLEM

Health data reviewed thus far indicate an elevation in the incidence of cancers of the blood forming organs, particularly of leukemia, among the residents of the five coastal communities studied. This elevation is statistically significant among males. No elevation was found for cancers of the breast and thyroid, though none would have been expected even if there had been sufficient radiation exposure to induce these types of cancer. This is because breast and thyroid cancers generally take more years to develop after they are initiated by some causal factor like radiation than the number of years the Pilgrim plant has been operational.

The biological significance of the incidence of leukemia in relation to possible radiation emissions from the Pilgrim plant cannot be fully determined from the available data. No clear pattern or gradient of cancers around the plant is apparent. Generally, if some point source, such as Pilgrim, is suspected of emitting pollutants then those at greatest risk of exposure would be those living closest to the plant. Those individuals with the greatest exposure would also be those with the greatest risk of disease caused by that exposure. This is because as dose of exposure increases, so usually does the frequency of disease (dose-response relationship). Therefore, one might expect to see more leukemia among those living closest to Pilgrim and less as the distance from Pilgrim increases, if emissions are causing leukemia. This was not observed. It should be noted, though, that many of the surrounding towns are sparsely populated and, therefore, a gradient might be difficult to identify. Furthermore, if the ability of radiation to induce leukemia is

approximately the same for widely differing doses of exposure, then a gradient might again not be evident. Furthermore, the off-site radiation measurement data reviewed so far (the levels of radiation residents of the surrounding communities are exposed to) are not consistent with the development of adverse health outcomes, based upon current medical knowledge.

Interpretation of the health data currently known for the Plymouth area requires a certain understanding of the limitations and value of the data before definitive conclusions can be drawn. The Commonwealth has mandated the reporting of all new cases of cancer since 1982. On the average, there is a six month lag between diagnosis and the report arriving at the Massachusetts Cancer Registry, located at and administered by MDPH. The reporting hospital is required to report any changes made in the diagnosis of cases previously reported to the Registry.

Additionally, the Cancer Registry regularly conducts quality control checks. This process includes checks on the reported diagnosis, as well as the completeness of case ascertainment. These quality control procedures are in line with the procedures used by cancer registries in other states and those supported by the National Cancer Institute, and assure the validity of the cancer incidence data.

Any changes made in the Registry data as a result of these processes often result in the revision of incidence rates for specific cancers and for specific towns. This has occurred since August 1986 when the Registry learned that a female leukemia case in Plymouth had mistakenly been reported by a hospital as a male resident of Scituate. The correction of this error altered the number of hematopoietic and reticuloendothelial

cancers in the five towns from 32 males and 20 females to 31 males and 21 females.

The Cancer Registry data are routinely used for the purpose of surveillance. This involves comparing the incidence of specific cancer(s) between communities or between communities and the state. The comparisons are often complicated by year-to-year fluctuations in the rates due to the small numbers of reported cases and the small population size of many communities. Consequently, there is often little statistical confidence in the observed differences between the incidence rates. Additionally, current cancer incidence data are of limited use for assessing time trends (to indicate increasing or decreasing incidence rates) in a particular community or region because incidence data are presently available for only three years (1982-1984).

Even with stable rates and large populations, descriptive analyses, such as that presented in this report, only provide information as to the possible existence of a problem and not to the cause(s) of the problem. Regarding leukemia in the Plymouth area, a broad spectrum of risk factors may have contributed to the observed incidence.

Occupational exposures, particularly among those who work in the rubber and leather industries, have been implicated in epidemiologic research as risk factors for leukemia. Exposure to benzene, for example, is a documented risk factor for leukemia. Use of certain cytotoxic drugs such as chloramphenicol, and radiation received in the course of diagnostic tests or treatment are also considered as possible causes of leukemia. The past residential histories of cancer cases is also of importance in order to determine if there is a relationship between previous residence

of a case and proximity to the Pilgrim plant. Proximity to the Pilgrim plant acts as a proxy measure of the potential for exposure and the intensity of that exposure. That is, the closer an individual lives to the plant, the greater the potential of exposure. Similarly, the length of residence acts as a proxy measure for duration of exposure.

Available information on these important factors is presently limited or nonexistent. It is, therefore, not yet possible to establish whether there is a cause and effect relationship between the observed leukemia incidence and exposure to possible radiation emissions from the Pilgrim plant.

CONCLUSION

These analyses of health data have revealed no disturbing trends in either the patterns of cancer mortality or in the expression of low birthweight and infant mortality. Presently, radiation monitoring records do not suggest any significant levels of radiation off-site of the Pilgrim plant (the levels of radiation residents of the surrounding communities are potentially exposed to). However, a statistically significant increase in the incidence of cancers of the blood forming organs, primarily leukemia, among males in the five coastal towns has been identified. The number of leukemia cases diagnosed among female residents of the five towns were also higher but not significantly higher than expected.

This review has established that there is an apparent excess risk of leukemia incidence in the five towns combined. But limitations in the data available for this investigation preclude an assessment of the magnitude of public risk from exposure to air emissions from the Pilgrim Nuclear Facility. Major gaps exist in our present understanding of the relationship of the nuclear facility with the health status of the residents of Plymouth and surrounding communities. The major gaps include a full characterization of occupational history, residential history, and medical history concerning the leukemia cases.

In response to concerns regarding the elevated incidence in the communities investigated, MDPH has considered several approaches to a comprehensive study of the cancer incidence. The objective of the study MDPH is committed to conduct will be to overcome the limitations of the present health data. This would be accomplished through the collection of

information regarding possible causes of leukemia, including emissions from the Pilgrim plant, by means of interviews with cases. The study will be designed to include a sufficient number of cases and explore possible causes of the observed excess of leukemia in these communities. Such a study will require resources that are currently unavailable to MDPH.

residents of Plymouth, by census tracts

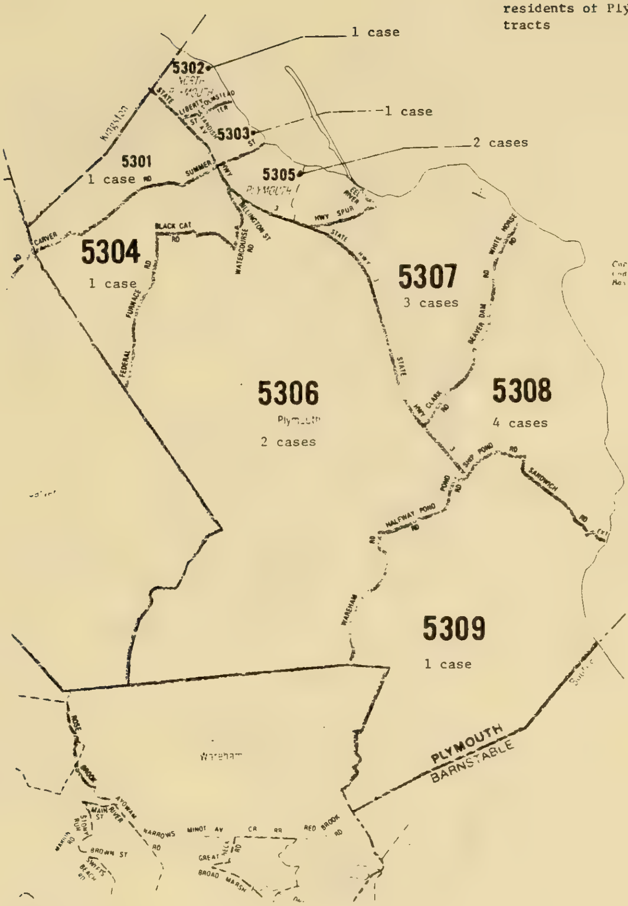


FIGURE 2

Number of cases of leukemia, multiple myeloma, and other rare cancers of the blood forming organs diagnosed in 1982-84 among the residents of Duxbury, Kingston, Marshfield, and Scituate, by census tracts

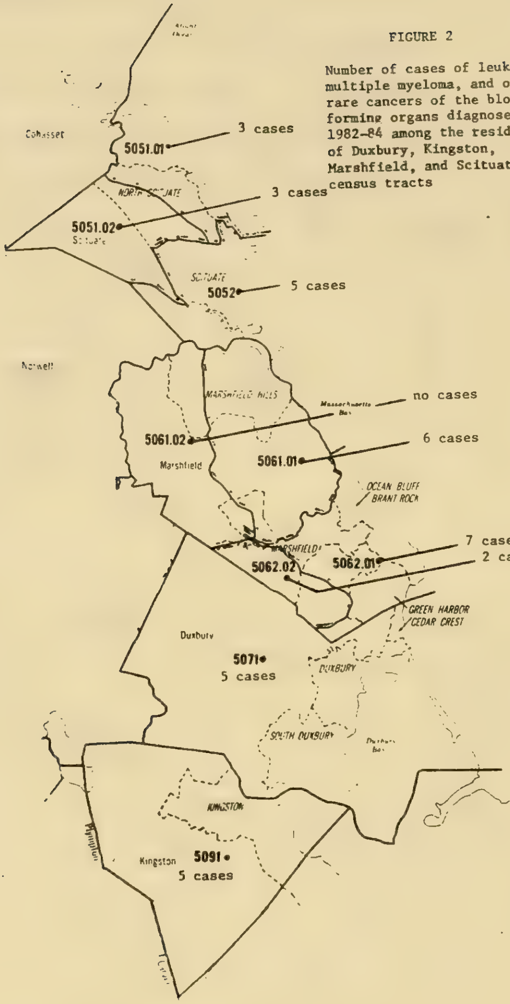


FIGURE 3

INFANT MORTALITY RATE
IN PLYMOUTH, PLYMOUTH COUNTY, AND MASSACHUSETTS
1969 - 1984

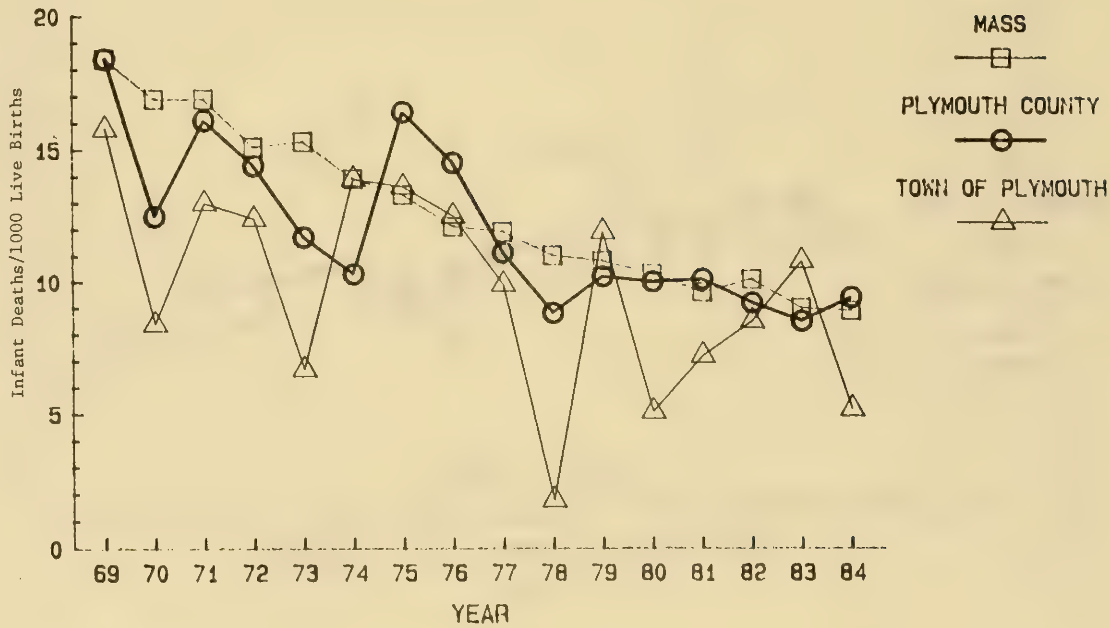


FIGURE 4

PERCENT OF LOW BIRTHWEIGHT
IN PLYMOUTH, PLYMOUTH COUNTY, AND MASSACHUSETTS
1969 - 1984

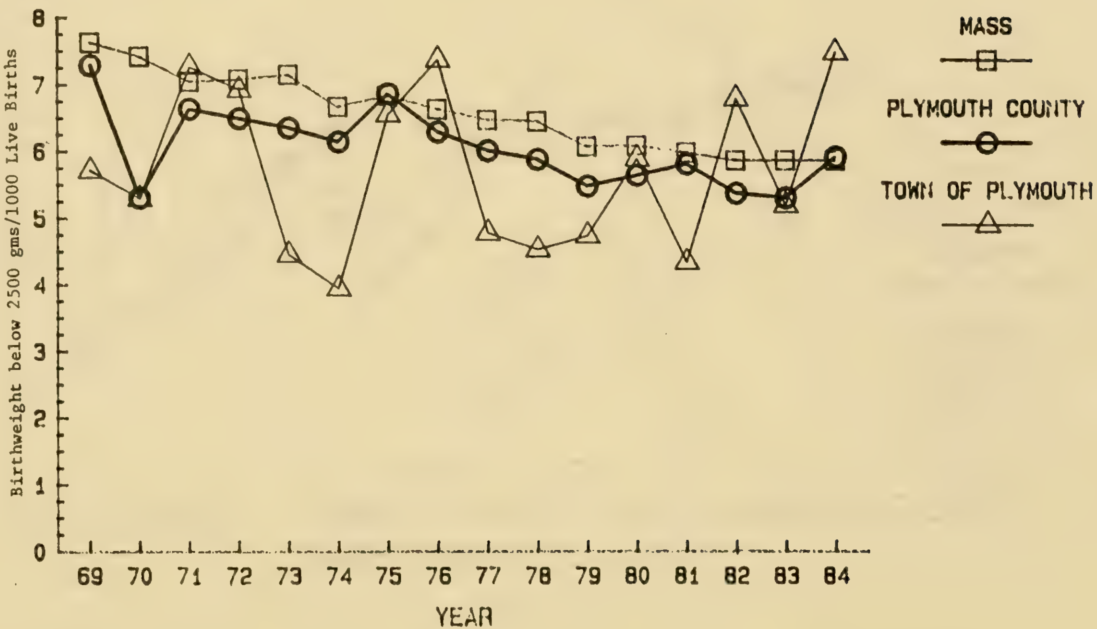


TABLE I

The numbers of observed and expected breast cancer deaths among female residents of Plymouth, the five coastal towns, and the remaining towns of Plymouth county for two time periods.

	1969-1973 Observed/Expected	1979-1983 Observed/Expected
Plymouth	16/21.5	29/33.2
Five Towns Combined	56/54.9	84/79.6
Rest of Plymouth County	214/219.6	284/269.8

Source: Division of Health Statistics & Research, Massachusetts Department of Public Health

TABLE 2

The numbers of observed and expected leukemia deaths among the residents of Plymouth, the five coastal towns, and the remaining towns of Plymouth county for two time periods.

		1969-1973 Observed/Expected	1979-1983 Observed/Expected
Plymouth	Males	6/4.3	5/6.9
	Females	5/3.6	7/5.9
Five Towns Combined	Males	8/11.7	16/16.3
	Females	12/9.4	16/13.8
Rest of Plymouth County	Males	43/47.3	44/54.7
	Females	47/37.4	43/47.1

Source: Division of Health Statistics & Research, Massachusetts Department of Public Health

Table 3

The numbers of observed and expected incident cases of cancers of the hematopoietic and reticuloendothelial system diagnosed among the residents of Plymouth and the five coastal towns between 1982 and 1984.

		Observed*	Expected
Plymouth	Males	10	7.5
	Females	7	6.6
Five Towns Combined	Males	31	18.1**
	Females	21	15.2

* Observed numbers reflect corrections reported by hospitals since August, 1986

** Statistically significant difference (p<.05)

Source: Division of Health Statistics & Research, Massachusetts Department of Public Health

TABLE 4a

The numbers of observed and expected incident cancers of the hematopoietic and reticuloendothelial systems, excluding chronic lymphocytic leukemia (CLL), diagnosed among the residents of the five coastal towns between 1982 and 1984.

	Observed	Expected
Males	28	14.8*
Females	17	12.6

TABLE 4b

The numbers of observed and expected incident cases of leukemia, all subtypes, diagnosed among the residents of the five coastal towns between 1982 and 1984.

	Observed	Expected
Males	22	12.1*
Females	12	9.3

TABLE 4c

The numbers of observed and expected incident cases of leukemia, excluding chronic lymphocytic leukemia (CLL), diagnosed among the residents of the five coastal towns between 1982 and 1984.

	Observed	Expected
Males	19	9.4*
Females	8	7.6

TABLE 4d

The numbers of observed and expected incident cases of myelogenous leukemia diagnosed among the residents of the five coastal towns between 1982 and 1984.

	Observed	Expected
Males	13	5.2*
Females	6	4.8

* statistically significant difference ($p<.05$)

Source: Division of Health Statistics & Research, Massachusetts Department of Public Health

Appendix I

Observed and expected numbers of deaths from leukemia among the residents of selected towns in Southeastern Massachusetts, 1969-1973 and 1979-1983

	1969 - 1973		1979 - 1983	
	Observed	Expected	Observed	Expected
Barnstable				
Males	3	4.9	11	8.0
Females	3	3.8	12	7.0
Bourne				
Males	4	2.1	4	2.9
Females	5	1.7	1	2.1
Bridgewater				
Males	2	2.2	0	2.6
Females	0	1.4	0	2.1
Carver				
Males	0	0.5	2	1.1
Females	1	0.3	1	0.7
Duxbury				
Males	1	1.5	2	1.9
Females	0	1.1	2	1.5
East Bridgewater				
Males	0	1.5	1	1.6
Females	0	1.1	1	1.4
Halifax				
Males	0	0.5	1	1.1
Females	0	0.4	1	0.8
Hanover				
Males	1	1.3	1	1.5
Females	1	1.0	0	1.2
Hanson				
Males	0	1.2	0	1.3
Females	1	0.8	2	1.0
Kingston				
Males	0	1.1	1	1.4
Females	2	0.8	3	1.1
Marion				
Males	1	0.7	1	0.9
Females	0	0.5	2	0.6
Marshfield				
Males	0	2.3	5	3.1
Females	3	1.7	3	2.5

Appendix I (con't)

	1969 - 1973		1979 - 1983	
	Observed	Expected	Observed	Expected
Mashpee				
Males	1	0.3	3	1.0
Females	0	0.2	0	0.8
Middleborough				
Males	0	2.7	2	3.0
Females	1	2.3	3	2.8
Norwell				
Males	2	1.0	1	1.4
Females	2	0.8	0	1.3
Pembroke				
Males	1	1.5	2	1.8
Females	1	1.1	1	1.5
Plymouth				
Males	6	4.3	5	6.9
Females	5	3.6	7	5.9
Plympton				
Males	0	0.2	0	0.3
Females	0	0.1	0	0.2
Rochester				
Males	1	0.4	0	0.5
Females	0	0.2	0	0.4
Rockland				
Males	1	2.6	1	2.6
Females	4	2.1	4	2.3
Sandwich				
Males	0	1.0	2	1.9
Females	0	0.7	4	1.4
Scituate				
Males	1	2.5	3	3.0
Females	2	2.2	1	2.8
Wareham				
Males	2	2.7	4	4.4
Females	5	1.9	2	3.5
Whitman				
Males	2	2.2	2	2.2
Females	2	1.9	3	1.9

Appendix II
Observed and expected numbers of cancers of the blood forming organs diagnosed among the residents of selected towns in Southeastern Massachusetts, 1982-1984

	Observed		Expected	
	Males	Females	Males	Females
Barnstable	12	13	11.0	10.0
Bourne	6	2	3.8	3.5
Bridgewater	1	2	2.7	1.8
Carver	1	0	1.7	0.0
Duxbury	3	2	1.8	1.5
East Bridgewater	2	2	1.9	1.6
Halifax	1	1	1.2	0.6
Hanover	2	1	1.5	1.6
Hanson	1	0	1.1	0.0
Kingston	3	2	1.3	1.2
Marion	1	2	1.3	0.6
Marshfield	10	5	4.3	2.6

Appendix II (con't)

	Observed		Expected	
	Males	Females	Males	Females
Mashpee	0	0	0.0	0.0
Middleborough	2	3	3.7	2.9
Norwell	3	1	1.2	1.3
Pembroke	1	2	1.3	1.4
Plymouth	10	7	7.2	6.8
Plympton	0	0	0.0	0.0
Rochester	0	1	0.0	0.4
Rockland	1	1	2.8	2.2
Sandwich	3	0	2.3	0.0
Scituate	5	5	3.4	3.1
Wareham	4	2	3.5	2.7
Whitman	7	4	2.5	1.7

(Appendix B)

COMMONWEALTH OF MASSACHUSETTS. JOINT COMMITTEE ON ENERGY

Testimony of Sidney Cobb MD, March 24, 1987

Last week I read a paper before the American Epidemiologic Society on behalf of my coauthors R. W. Clapp, C. K. Chan, & Bailus Walker, Jr. In this paper I detailed the information leading to the conclusion that there is an excess of leukemia in the five coastal towns north from Plymouth to Scituate. This is now a well accepted conclusion and has been discussed before this committee and in the newspapers. I will not bore you with a repeat of the evidence, but I want to reemphasize that the excess is very small when compared to the ordinary hazards of life.

I want to give you the reasons that I suspect this excess leukemia might be attributable to airborne radioactive effluents from the Pilgrim I nuclear power plant.

1. A closer examination of the residential location of the cases reveals that essentially all of the extra cases live within four miles of the coast in a strip about 20 miles long.

2. There are several factors which might tend to contain the radioactive effluent from the plant in such a narrow area. The first is the coastal circulation of air that is depicted in figure 3. It is easy to imagine how an injection of pollutants to the middle of such a pattern might be contained and carried along the coast. The second is the fact that two to four miles inland the land rises rather sharply providing a geographic containing wall'. The third is the fact that coastal fogs are not uncommon in this area and there is new information suggesting that fog can trap residues from pesticide spraying. Perhaps it might also trap radioactive materials.

3. We have examined other possible explanations for this very narrow band of excess leukemia and have found none satisfactory. There does not seem to be any clustering of cases by occupation, and the distribution does not fit the distribution of any water or milk supply nor is there a known collection of toxic waste dumps spread along this coast.

4. In Maine there is an outbreak of leukemia that is similarly located in time and space with respect to the Maine Yankee plant at Wiscasset. This has as yet not been thoroughly investigated because it was overlooked by the group who made the original

investigation of leukemia in that area. It is, however, quite striking and according to data from the Maine cancer register appears to be continuing.

5. There was a particular period in the early life of the plant during which the radioactive emmissions were substantially greater than usual and on more than one occasion exceeded technical standards. The worst period was the 12 months from last quarter of 1974 through the third quarter of 1975. See figure 1.

6. The increase in leukemia appears to have taken place about five years after this period of extra emissions. Five years is just about the expected incubation time for radiogenic leukemia.

7. If these releases in 1974-5 were sufficient to produce leukemia one would expect to see some adverse reproductive outcomes appearing within a few months of the exposure. Assuming that the critical period to examine was 1975-6 we proceeded to rank the 26 health service areas in the state with respect to the size of the bulge in that two year period when compared with the two years before and the two years afterward. The ranking was done first on infant mortality rate (IMR) and second on congenital defects reported on birth certificates (CDR). The result is shown in table 1 and the maps on the last page of the handout. The top six in the IMR ranking contain the top five in the CDR ranking. All the selected areas are either north along the coast or adjacent to area 53 which contains the town of Plymouth. This distribution is highly unlikely to have occurred by chance ($P < 0.0002$). This finding clearly needs further exploration, but the hypothesis of radiogenic health effects resulting from the extra emissions from Pilgrim I in 1974-5 is supported.

To me, the above evidence is quite suggestive enough to urge continuation of the investigation. A causal relation is far from proven, but the suggestion of possible causation should receive serious further consideration.

If the investigations to date should be supported by further local research and by further findings around other coastal nuclear installations, we will be forced to conclude that in the future the standards must be set low enough to preclude releases such as came from the Pilgrim plant in the middle seventies. This would be facilitated by passage of House Bill 5188.

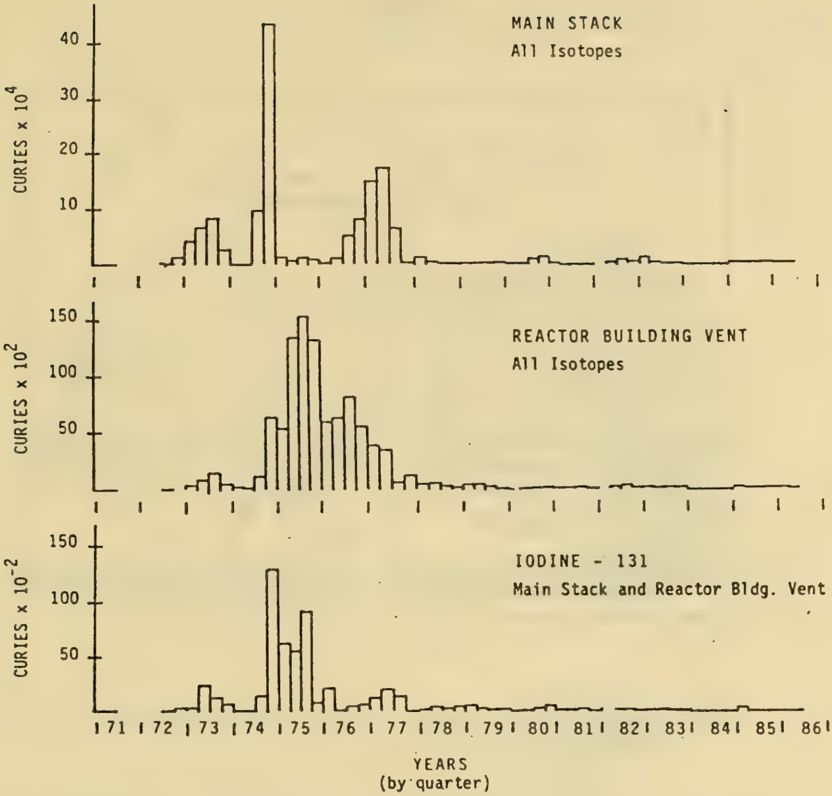
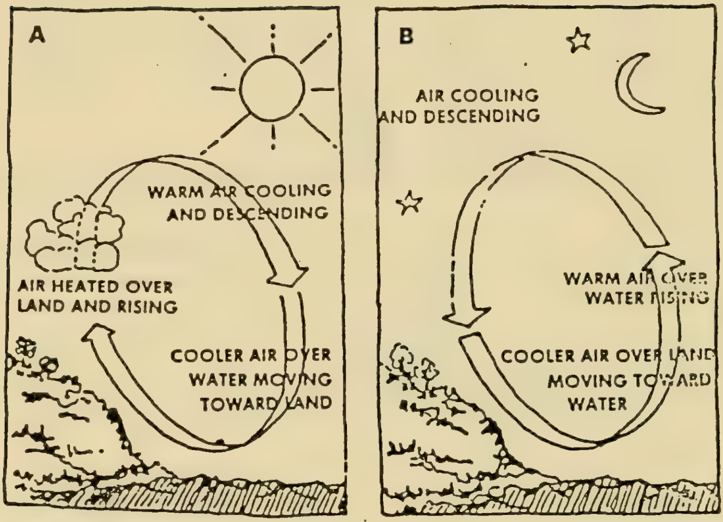


Fig. 1 Airborne radioactive effluents from Pilgrim I nuclear reactor in Plymouth, MA, by quarter, 1972-1986.

(Source: Boston Edison <u>Semi-Annual Effluent Reports</u> to USNRC)

FIGURE 3.



Land and sea breezes.

SOURCE: Field F: Dr. Frank Field's Weather Book. New York: G.P. Putnam's Sons, 1981.

TABLE 1 TOP RANKING HSAS FOR THE PERIOD 1975-6 IN EXCESS INFANT MORTALITY AND CONGENITAL DEFECT RATIOS

RANK	IMR		CDR	
	HSA	RATIO	HSA	RATIO
1	5-3	1.7	6-1	1.8
2	5-6	1.6	6-3	1.8
3	5-2	1.4	5-2	1.8
4	6-1	1.2	5-3	1.6
5	6-3	1.2	6-5	1.6
6	6-5	1.2	5-1	1.5

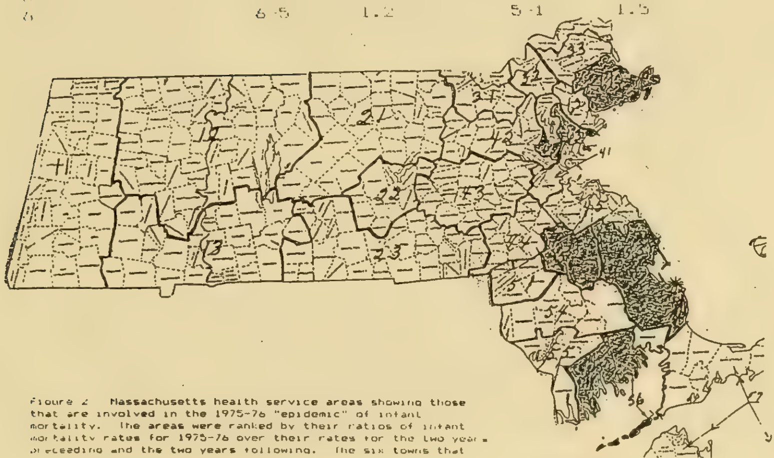


Figure 2 Massachusetts health service areas showing those that are involved in the 1975-76 "epidemic" of infant mortality. The areas were ranked by their ratios of infant mortality rates for 1975-76 over their rates for the two years preceeding and the two years following. The six towns that are shaded are the top six in this ranking.

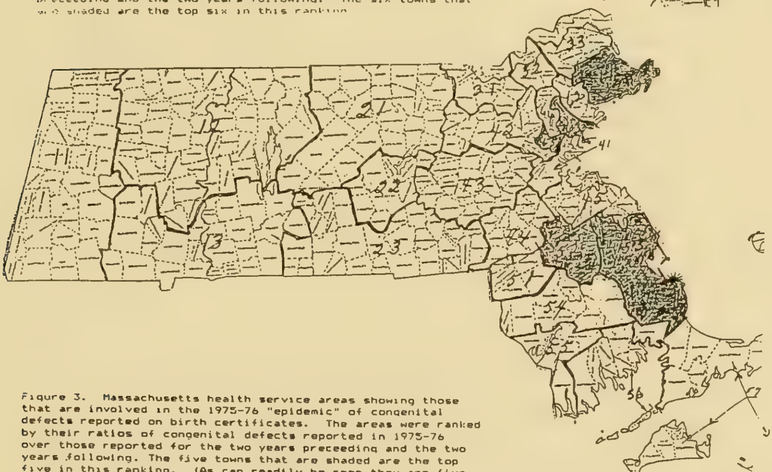


Figure 3. Massachusetts health service areas showing those that are involved in the 1975-76 "epidemic" of congenital defects reported on birth certificates. The areas were ranked by their ratios of congenital defects reported in 1975-76 over those reported for the two years preceeding and the two years following. The five towns that are shaded are the top five in this ranking. (As can readily be seen they are five of the six towns shaded on the previous map)

INFANT MORTALITY - MASSACHUSETTS - 1975 & 1976

Rank	HSA	Live Births	Infant deaths Observed	Infant deaths Expected*	Obs/Exp Ratio	Number Excess Deaths
1	5-3	3,668	60	34.9	1.7	25.1
2	5-6	3,93[illegible]	73	45.6	1.6	27.4
	5-2	5,536	92	64.4	1.4	27.6
4	6-1	2,201	31	26.8	1.2	4.2
5	6-3	2,976	39	33.7	1.2	5.3
	6-4	3,457	44	37.8	1.2	6.2
Totals		21,77[illegible]	339	243.2		95.8

* expected number of infant deaths calculated by:

$$[illegible] = \frac{\text{(infant deaths in 1973,74,77,78)}}{\text{(live births in 1973,74,77,78)}} * \text{(live births in 1975,76)}$$

Perkins
30 March 1987
Massdata

CONGENITAL DEFECTS* - MASSACHUSETTS - 1975 & 1976

Rank	HSA	Live Births	Congenital Defects Observed	Congenital Defects Expected**	Obs/Exp Ratio	Number Excess Defects
1	6-1	2,201	29	16.0	1.8	13.0
2	6-3	2,978	26	14.2	1.8	11.8
3	5-2	5,536	55	31.5	1.7	23.5
4	5-3	3,668	42	25.8	1.6	16.2
5	6-5	3,457	35	22.0	1.6	13.0
6	5-1	2,254	26	17.4	1.5	8.6
Totals		20,094	213	126.9		86.1

* congenital defects recorded on birth certificates

** expected number of congenital defects calculated by:

$$\text{exp \#} = \frac{\text{(cong. defects in 1973,74,77,78)}}{\text{(live births in 1973,74,77,78)}} * \text{(live births in 1975,76)}$$

Perkins
30 March 1987
Massdata

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INFANT MORTALITY AND CONGENITAL DEFECTS - FIVE COASTAL TOWNS - 1970-1984

TOWN/YEAR	1970	1971	1972	1973	1974	1975	1976	1977
				Total Live Births				
Duxbury	124	109	131	123	124	114	104	125
Kingston	135	106	111	112	111	93	101	[illegible]
Marshfield	292	307	271	311	299	268	277	[illegible]
Plymouth	359	385	404	448	431	442	515	[illegible]
Scituate	248	200	178	193	161	180	148	[illegible]
Totals	1,158	1,107	1,095	1,187	1,126	1,097	1,145	1,290
				Congenital Defects*				
Duxbury			0	0	2	1	0	0
Kingston			0	1	1	0	2	1
Marshfield			3	2	1	4	0	1
Plymouth			7	4	6	8	5	1
Scituate			0	1	4	2	1	2
Totals			10	8	14	15	8	5
CDR			9.13	6.74	12.43	13.67	6.99	[illegible]
				Infant deaths				
Duxbury	2	0	2	1	7	1	2	1
Kingston	2	3	3	0	1	2	0	0
Marshfield	0	3	2	6	1	6	3	2
Plymouth	3	5	5	3	6	6	9	[illegible]
Scituate	4	2	2	5	0	2	1	0
Totals	11	13	14	15	15	17	15	9
IMR	9.50	11.74	12.79	12.64	13.32	15.50	13.10	[illegible]

* congenital defects reported on birth certificates

1978	1979	1980	1981	1982	1983	1984
130	126	147	140	161	165	155
97	94	97	97	117	103	112
299	309	327	308	321	304	329
551	590	594	552	588	558	575
175	182	194	180	209	201	233
1,252	1,301	1,359	1,277	1,396	1,331	1,404
1	0	1	4	1	0	1
0	2	2	0	1	0	2
1	4	1	1	1	2	3
3	2	6	1	4	1	7
1	0	1	1	2	1	3
6	8	11	7	9	4	16
4.79	6.15	8.09	5.48	6.45	3.01	11.40
0	1	0	1	0	2	2
1	0	0	0	1	1	3
0	2	4	2	5	0	1
1	7	3	4	5	6	3
3	0	0	0	0	1	5
5	10	7	7	11	10	14
3.99	7.69	5.15	5.48	7.88	7.51	9.97

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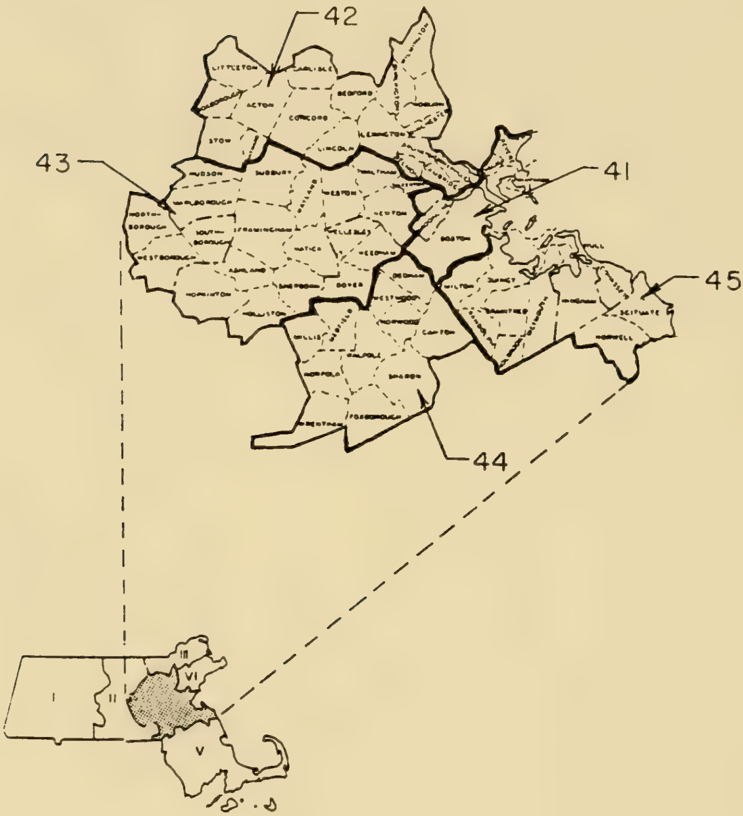
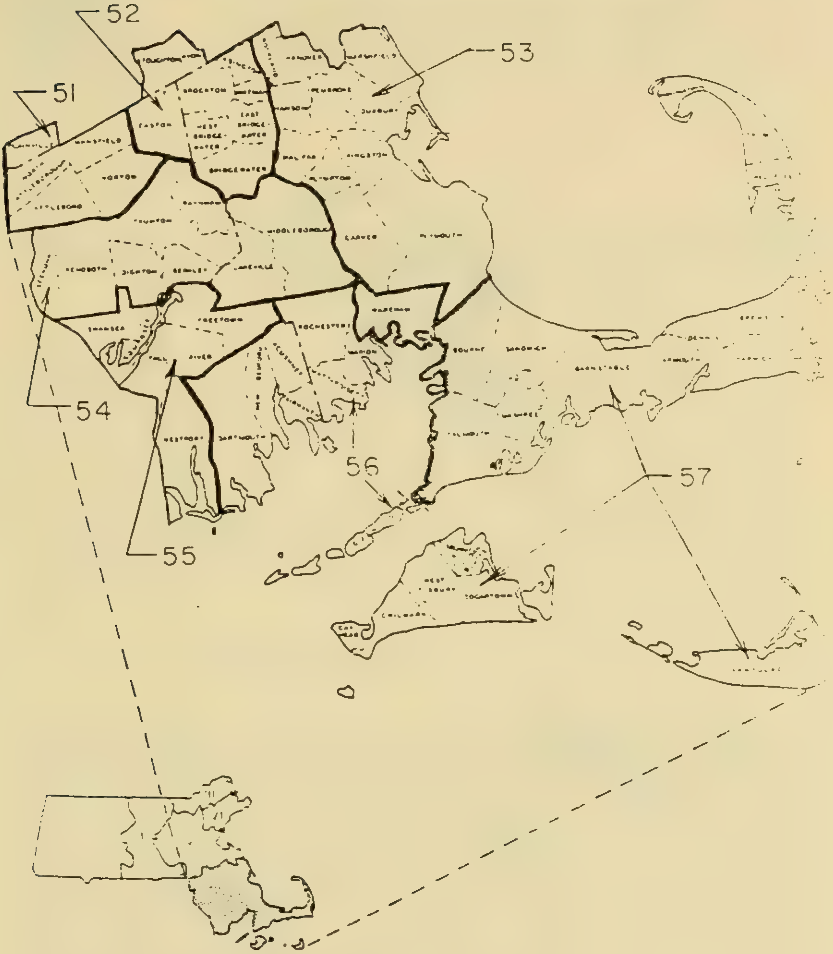
Source: Mass DPH Annual Reports

HEALTH SERVICE AREA IV

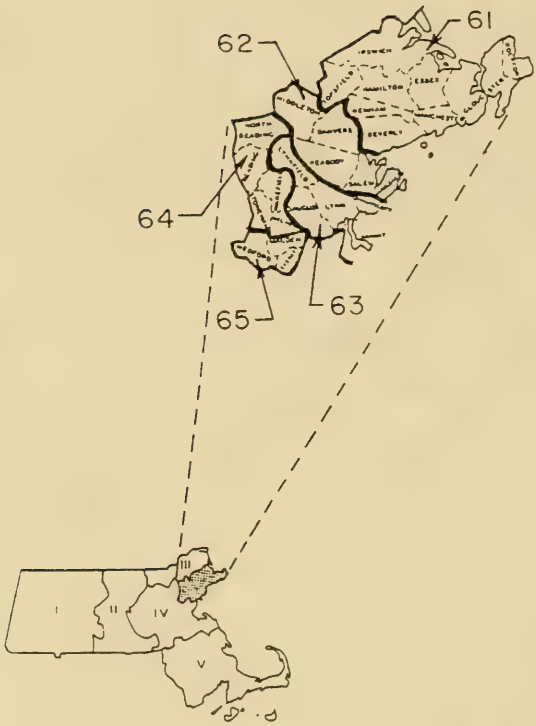


HEALTH SERVICE AREA V*



*INCLUDES ACTIVE AND INACTIVE SUBAREA COUNCILS.

HEALTH SERVICE AREA VI



(Appendix C)

NEWSLETTER

COUNCIL ON ECONOMIC PRIORITIES

December, 1986 **CEP Publication N86 - 12**

Public Health

Nuclear Emissions Take Their Toll

By Jay M. Gould with Brian Jacobs, Celia Chen and Steven Cea

Chernobyl has raised the universal question of what is the true impact on public health of nuclear emissions. This newsletter, the fifth in a series of reports and publications by the Council on Economic Priorities on the geographic dangers of toxic waste, will review some of the evidence linking nuclear emissions in the US to increases in mortality rates.

A state is often too crude a geographic unit for the measurement of environmental dangers since these dangers are generally local and seldom impact to the same degree on all or most localities in a state. As a preliminary effort, however, statewide and county variations in total infant and cancer mortality rates can be used to appraise current regional variations in public health.

Economy Determines Mortality

The advance of any modern industrial society can be traced in terms of the systematic decline in its mortality rates over time and the consequent increase in the longevity of its population. This is true of the US over the past two hundred years or more, and certainly so in the 20th Century when the official mortality statistics became representative of the total population. The US total mortality rate stood at 17.2 deaths per 1,000 persons in 1900 and declined at an average annual rate of one percent to stand at 8.7 deaths per 1,000 persons in 1980. The annual decline in mortality rates can, of course, be expected to slow as the population ages over time. Thus the mortality rate, when adjusted for differ-

The Calculation of Excess Mortality

Insight into the probable consequences of the Chernobyl disaster can be gained through US Mortality data for areas exposed to nuclear emissions, provided the total volume of curies of radioactive materials released is known. This newsletter explores the impact on public health of the release (routine and accidental) of some 35 million curies of all noble gases and radioactive particulates emitted from all civilian nuclear power reactors in the US in the years 1974–1981, as tracked by the Brookhaven National Laboratory. Our analysis indicates that such releases (detailed in Table 4) based on mortality data for states most directly affected by such emissions, are associated with nearly 9,000 excess deaths each year.

Brookhaven emissions surveys are extremely conservative. They do not cover emissions from the plutonium producing Hanford and Savannah River military reactors. The Atomic Energy Commission has been extremely sanguine about possible nuclear contamination of communities situated downwind from military reactors.

The Portland Oregonian (on May 11 and 12, 1986) revealed, on the basis of some 19,000 pages of classified data obtained as the result of FOIA, that the Hanford military reactors in Benton County, Washington, apparently released into the air 446,700 curies of radioactive Iodine-131 in the years 1945 to 1950, and an additional 7,616 curies in the years 1951–1961. This represents staggeringly high radiation levels—only 14 curies of radioactive Iodine were reported to have been released by the Three Mile Island disaster in 1979. For example, in an experiment "related to the development of a monitoring methodology for intelligence regarding the emerging Soviet nuclear program," Hanford purposely released 5000 curies of radioactive Iodine on Dec. 2–3, 1949. One particular stretch of farmland, lying just downwind of Hanford, came to be known as "Death Mile." Nine of its ten families have been stricken with cancer since 1950. The full impact of these emissions on the area affected has never been estimated. It is time for private citizens in the US as well as the USSR and Europe to demand official evaluations of the loss of life from nuclear emissions. It is CEP's hope that the findings and methodology offered in this newsletter receive the critical attention of radiation physicists, epidemiologists, and public health officials. ■

Continued from page 1

ences due to age, declined somewhat more—from 17.8 in 1900 to 5.9 deaths per 1,000 in 1980.

The infant mortality rate (IMR)—defined as the number of deaths within the first year per 1,000 live births—does not require age adjustment and has declined much more rapidly. Over time, the IMR is very much affected by the change in relative health standards of nonwhites since the IMR for nonwhites generally has been about 50 percent higher than the IMR for all babies. In 1915, the first year in which the official infant mortality rate was considered accurate, the IMR was 99.8. The 1980 figure, at 12.6, represents an average annual decline of 3.2 percent over a 65-year period. The average annual decline in the IMR usually ranged between two and four percent in accordance with the degree to which nonwhites and poor whites enjoyed better health and nutrition in periods of economic expansion.

This fact is indicated by Table 1 which summarizes trends in infant mortality by five-year periods since 1915. Annual declines are seen to average below three percent in depression years and over four percent in the "prosperous" full employment war years. In the decade 1955-1964, the years when atmospheric bomb testing produced peak fallout levels, the average annual decline slowed to one percent, however. The signing of the test ban treaty in 1963 saw fallout levels dropping sharply, and the average rate of decline in the 1965-1979 period was again well over four percent.

Cancer Rates Steadily Increasing

As the overall US mortality rate reflects the gradual aging of Americans, so does the cancer mortality rate—it has been increasing for decades. But the cancer rate is increasing even after adjustment for age and now accounts for about 22 percent of all deaths.

These mortality rates, used to evaluate public health standards, are closely intertwined. Historically, modern industrial technology, along with advancing medical technology, has elevated nutrition and health standards. It has also contributed greatly to the systematic lowering of mortality rates. But over the past three decades, increasing cancer rates, even after age adjustment, represent the grim side of that equation. They reflect in large part the environmental deterioration accompanying modern industrial technology. CEP is committed to the exploration of these complex and often contradictory economic, environmental, and public health issues.

Infant Mortality Linked To Fallout

Of the three mortality rates, the IMR is by far the most sensitive to both economic and environmental change. It can respond to a major environmental change within months. Let us again refer to Table 1 that summarizes official US IMR data by five-year periods since 1915. The necessity of including nuclear radiation in measures of environmental degradation is indicated by the flattening out of the long secular decline in the average annual IMR that occurred in the bomb test years.

When attention was first drawn to this ominous change in the late sixties, pronuclear proponents asserted this flattening out in the annual rate of the declining IMR merely reflected the natural limits of medical technology and the possible exhaustion of the powers of antibiotics. This argument was called into question after the ban on atmospheric bomb testing by the immediate resumption of the average annual four percent decline in the US IMR. That there are such cities as Amsterdam and Yokohama today with IMR ratios of the order of four or five, as against the current US IMR of 11, indicates we are still far from reaching any "natural" limit.

A 1986 publication of the Children's Defense Fund has, however, just warned that another ominous alteration in infant mortality rates has occurred in the period 1981 to 1984—when "the annual rate of decline has slowed to approximately three percent." In this period, the black infant mortality rate was also twice that of white infants, the greatest disparity in 23 years. (Table 1 shows that nonwhite infant mortality rates have historically been most responsive to both economic and environmental changes. Average annual declines were close to six percent in prosperous periods such as 1945-49 and average annual declines less than one percent in the peak bomb test years.) The Children's Defense Fund offers much evidence that these recent changes can be attributed to cutbacks in Federal health, nutrition, and service programs. The hypothesis that emissions from nuclear reactors are also adversely affecting infant mortality rates for both white and black babies shall be explored below.

Most of the nation's civilian power reactors came on line in the seventies, particularly in 1974 and subsequent years. Routine and accidental emissions from these reactors have been tracked by the Brookhaven National Laboratory.

The following is a summary of the latest Brookhaven Report:

Emissions, All Noble Gases, Million Curies

	1974-1981	Total 1970-1981
Boiling Water Reactors	23.732	40.252
Pressurized Water Reactors	11.687	11.719
Totals	35.419	51.971

This newsletter investigates the statis-

Continued page 4

TABLE 1: INFANT MORTALITY RATES IN THE US, 1915-1979

Five Year period	Av. # Deaths per 1,000 Births: All Babies	Av. # Deaths per 1,000 Births: Nonwhite	Annual % Rates of Change: All Babies	Annual % Rates of Change: Nonwhite
1975 1979	14 4	22.1	-4.9	-4 6
1970 1974	18 4	27 6	-4.2	-5 7
1965 1969	22.7	36.5	-2 2	-2 7
1960 1964	25 3	41.6	-0 9	-1.0
1955 1959	26.4	43.7	-1 3	-0.5
1950-1954	28.1	44 8	-3 6	-2.2
1945 1949	33.5	49 8	-4.9	-6.2
1940-1944	42 6	67.2	-4.6	-3.9
1935-1939	53.2	81 3	-2 6	-3.9
1930 1934	60 4	98 6	-2.7	-1 4
1925-1929	69 0	105 4	-2 2	-1.8
1920 1924	76 7	115 3	-4 7	-5.3
1915 1919	95.7	149.7	—	—

Source: *Vital Statistics of the U.S., 1980, Vol. II, Mortality, Part A, Section 2, Infant Mortality, page 1*

TABLE 2: AVERAGE ANNUAL MORTALITY RATES, 1965-69 AND 1975-82 BY STATE AND REGION

	ANNUAL AVERAGE 1965-1969								ANNUAL AVERAGE 1975-1982								RATIOS OF CHANGE		
	BIRTHS	INFANT DEATHS	IMR	POP (TH)	DEATHS	MR	CANCER DEATHS	CMR	BIRTHS	INFANT DEATHS	IMR	POP (TH)	DEATHS	MR	CANCER DEATHS	CMR	IMR RATIO	MR RATIO	CMR RATIO
US	[illegible]	[illegible]	[illegible]	[illegible]	1870238	9.5	309907	157.4	3394435	45561	13.4	[illegible]	1931224	[illegible]	394011	[illegible]	0.546	[illegible]	1.141
REGION																			
STATES																			
NEW ENGLAND	[illegible]	4045	[illegible]	11329	[illegible]	10.4	20753	183.2	156025	[illegible]	[illegible]	[illegible]	110743	9.0	[illegible]	205.8	0.561	0.867	1.115
*ME	[illegible]	[illegible]	19.0	984	10864	11.0	1814	184.9	15647	155	[illegible]	[illegible]	10707	9.3	2745	201.8	0.519	0.859	1.092
NH	[illegible]	[illegible]	[illegible]	692	7260	10.5	1282	185.7	12589	116	9.2	[illegible]	7356	8.2	1661	185.4	0.464	0.783	1.001
*VT	[illegible]	[illegible]	[illegible]	421	4563	[illegible]	[illegible]	[illegible]	7157	70	9.8	[illegible]	4380	[illegible]	912	182.3	0.493	0.804	1.057
*MA	[illegible]	[illegible]	[illegible]	5408	59304	11.0	10315	[illegible]	[illegible]	[illegible]	11.0	5755	[illegible]	[illegible]	12001	208.5	0.553	0.847	1.093
*RI	[illegible]	341	[illegible]	901	[illegible]	[illegible]	1778	197.3	11986	170	14.2	953	9221	9.7	2151	225.6	0.685	0.918	1.143
*CT	50166	[illegible]	[illegible]	2922	25935	[illegible]	4832	165.3	36685	435	11.9	3107	[illegible]	8.4	6152	198.0	0.596	0.943	1.197
MIDDLE ATLANTIC	624612	13720	[illegible]	36746	379695	10.3	67948	184.9	485914	6710	13.8	37008	352678	9.5	76788	207.5	[illegible]	0.922	1.122
*NY	316768	7048	22.3	18064	187700	10.4	34171	189.2	238206	3446	14.5	17756	167766	9.4	36670	206.5	0.650	[illegible]	1.092
*NJ	114861	2402	20.9	6978	65102	9.3	12405	177.8	91542	1129	12.3	7374	64995	8.8	14977	203.1	0.590	0.945	1.143
*PA	192983	4270	22.1	11704	126893	10.8	21372	182.6	156172	2134	[illegible]	11878	119917	10.1	25141	[illegible]	0.618	0.931	[illegible]
EAST NORTH CENTRAL	717885	15682	21.8	39166	371057	9.5	62907	160.6	632173	8464	13.4	41467	358145	[illegible]	74396	179.4	0.613	0.912	1.117
*OH	187946	3860	20.5	10503	99262	9.5	16931	161.2	163209	2124	13.0	10784	96324	[illegible]	20184	[illegible]	0.634	0.945	[illegible]
*IN	[illegible]	2050	[illegible]	5016	[illegible]	9.5	7600	155.4	84485	1066	12.6	[illegible]	47044	[illegible]	9520	175.1	0.575	0.910	1.126
*IL	[illegible]	[illegible]	[illegible]	10870	[illegible]	10.0	16354	168.9	176708	2677	15.1	[illegible]	100416	[illegible]	[illegible]	[illegible]	0.633	[illegible]	[illegible]
*MI	[illegible]	3585	22.0	8561	74845	[illegible]	12877	150.1	137566	1878	13.7	[illegible]	74149	8.1	[illegible]	168.1	0.620	[illegible]	1.120
*WI	77154	1484	19.2	4194	40394	9.6	6947	165.6	70205	719	10.2	4662	40210	8.6	[illegible]	[illegible]	[illegible]	[illegible]	1.076
WEST NORTH CENTRAL	279660	5543	19.8	16008	163935	10.2	26805	167.4	271081	3428	12.6	17063	[illegible]	9.2	31462	184.5	0.638	[illegible]	1.102
*MN	66301	1235	18.6	3624	33527	[illegible]	5767	158.9	63172	728	11.5	4029	33010	8.2	6791	168.5	0.619	[illegible]	1.061
*IA	48902	[illegible]	[illegible]	2771	29521	10.7	4830	174.3	45090	507	11.3	2908	27040	9.3	5518	189.7	0.584	[illegible]	1.068
MO	80220	1757	21.9	4575	52026	11.4	8171	178.6	75737	1148	15.2	4680	49789	10.2	9804	201.0	[illegible]	0.897	[illegible]
ND	11902	[illegible]	19.1	633	5639	[illegible]	922	145.6	12347	162	13.1	[illegible]	5664	8.7	1088	166.8	0.688	0.975	1.146
SD	12009	261	[illegible]	673	6509	9.7	1072	159.3	12219	151	12.4	686	6396	9.3	1212	176.1	[illegible]	0.961	1.106
*NB	25176	410	16.3	1449	14898	10.3	2518	[illegible]	25871	323	12.5	1563	14546	9.3	2893	[illegible]	0.768	0.905	1.066
KS	35149	710	[illegible]	2278	21814	9.6	3525	154.7	36645	407	11.1	2342	21133	9.0	4170	178.0	0.550	0.942	1.151
SOUTH ATLANTIC	549057	13976	25.5	29637	276055	9.3	42176	142.3	520991	7919	15.2	36248	320918	8.9	[illegible]	181.2	[illegible]	0.951	1.273
*DE	10213	223	21.8	524	4904	9.4	780	148.9	8961	118	13.1	596	5040	8.5	1118	187.5	0.603	0.903	1.259
*MD	62382	1426	22.9	3660	31342	8.6	5565	152.0	51019	687	13.5	4214	32425	7.7	7551	179.2	[illegible]	[illegible]	1.179
*DC	28530	673	23.6	804	10513	13.1	1480	184.1	18163	442	24.3	664	[illegible]	13.1	1764	[illegible]	1.031	1.003	1.443
*VA	79611	[illegible]	[illegible]	4547	[illegible]	8.2	5840	128.4	72884	1036	14.2	5285	40453	7.7	8381	158.6	0.576	0.931	1.235
WV	30526	[illegible]	24.6	1819	[illegible]	10.8	[illegible]	162.2	29080	426	14.6	1916	19440	10.1	3621	189.0	0.594	[illegible]	1.165
*NC	93958	[illegible]	27.7	5068	43458	8.6	5804	114.5	83625	[illegible]	15.6	5775	47644	8.3	9085	157.3	0.563	0.962	1.374
*SC	50123	1398	27.9	2634	22066	8.4	2919	110.8	48484	830	17.1	3057	23853	7.8	4394	143.7	0.614	0.931	1.297
*GA	90399	2320	25.7	4510	39555	8.8	5423	120.2	87781	1294	14.7	5345	43667	8.2	7890	147.6	0.574	0.932	1.228
*FL	103316	2612	25.3	6071	67215	11.1	11415	188.0	120994	1780	14.7	9396	99682	10.6	21879	232.9	0.582	0.958	1.238
EAST SOUTH CENTRAL	245812	6768	27.5	12988	126134	9.7	17965	138.3	232995	3567	15.3	14405	132058	9.2	24997	173.5	0.556	0.944	1.255
KY	59054	1391	23.6	3205	31989	10.0	4817	150.3	58376	727	12.5	3603	32962	9.1	6448	179.0	0.529	0.917	1.191
*TN	73603	1858	25.2	3919	38466	9.8	5439	138.8	64524	1078	15.5	4462	41673	9.3	7928	176.9	0.614	0.947	1.274
*AL	65319	1839	28.2	3521	32862	9.3	4584	130.2	59996	971	16.2	3833	34588	9.0	6567	171.3	0.575	0.967	1.316
MS	47836	1680	35.1	2343	22817	9.7	3126	133.4	45099	[illegible]	17.6	2487	22834	9.2	4054	163.0	0.500	0.943	1.222
WEST SOUTH CENTRAL	363118	8633	23.8	19010	165622	8.7	26383	138.8	415029	5753	13.9	23114	190373	8.2	36606	158.4	0.583	0.945	1.141
*AR	34126	758	22.2	1973	19848	10.1	2990	151.5	34761	461	13.3	2241	21712	9.7	4226	188.6	0.596	0.963	1.245
LA	76263	2104	27.6	3663	[illegible]	9.0	5094	139.1	76743	1234	16.1	4118	35235	8.6	6793	164.9	0.583	0.947	1.186
OK	40468	869	21.5	2514	24370	9.7	3985	158.6	47463	620	13.1	2958	27290	9.2	5297	179.1	0.608	0.952	1.129
TX	212259	4902	23.1	10861	88297	8.1	14314	131.8	256062	3438	13.4	13797	106136	7.7	20291	147.1	0.581	0.946	1.116
MOUNTAIN	155932	[illegible]	22.1	[illegible]	63311	8.1	[illegible]	118.4	208613	2487	11.9	10917	[illegible]	7.1	14425	[illegible]	0.539	0.877	1.116
MT	12346	269	21.8	699	[illegible]	9.4	1004	143.6	13337	148	11.1	780	6519	8.4	1227	157.4	0.510	0.887	1.096
ID	12782	251	19.6	705	5786	8.2	893	126.7	18511	167	9.0	[illegible]	6362	7.0	1207	132.5	0.460	0.851	1.046
WY	5823	128	[illegible]	323	2822	8.7	[illegible]	121.7	8636	64	9.7	442	3033	[illegible]	[illegible]	[illegible]	0.443	0.786	0.984
CO	38034	838	22.0	2019	17256	8.5	2497	123.7	46947	560	11.9	2807	19034	6.8	3478	123.9	0.542	0.794	1.002
NM	21933	557	25.4	1004	7007	7.0	[illegible]	98.1	24450	299	12.2	1264	8441	[illegible]	1540	121.8	0.482	0.957	1.242
AZ	32610	[illegible]	23.5	1634	13204	[illegible]	2043	125.0	45519	614	[illegible]	2575	19983	7.6	4001	155.4	0.575	0.960	1.243
UT	23661	432	18.2	1020	7023	6.9	939	92.1	39592	469	11.3	[illegible]	[illegible]	5.9	[illegible]	[illegible]	[illegible]	0.856	1.034
NV	8744	207	[illegible]	442	3623	8.2	533	120.4	11622	147	12.6	745	5666	7.6	1115	149.6	0.531	0.928	[illegible]
PACIFIC	[illegible]	[illegible]	[illegible]	24114	206979	8.6	[illegible]	148.0	471609	5496	11.7	[illegible]	231479	[illegible]	49515	[illegible]	0.586	[illegible]	1.132
*WA	53940	[illegible]	[illegible]	3190	[illegible]	9.2	4833	151.5	60195	731	12.1	[illegible]	31298	[illegible]	6602	167.2	0.611	0.860	1.104
*OR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.103
*CA	345019	[illegible]	[illegible]	[illegible]	158651	8.4	27724	146.4	[illegible]	4271	11.5	[illegible]	[illegible]	7.8	38526	[illegible]	0.578	[illegible]	1.141

*NUCLEAR STATES IMR INFANT MORTALITY RATE (DEATHS/1000 BIRTHS) MR MORTALITY RATE (DEATHS/1,000 PERSONS) CMR CANCER MORTALITY RATE DEATHS/100,000 PERSONS

tical relationship between the 35.4 mil- ion curies emitted in the years 1974–1981 and infant and other mortality rates in the years 1975–1982 in states most directly affected.

For the purpose of this inquiry, the contiguous states (excluding Alaska and Hawaii) are divided into two groups—*nuclear states* (those with power or military reactors) and *nonnuclear states* (those without). Actually, the geographic distribution of reactors in the US is so wide that only 19 states can be regarded *nonnuclear*. Small states, like the District of Columbia or Rhode Island, lying directly downwind from reactors in adjoining states are included in the *nuclear* group.

Our definition of *nuclear* states (designated by an asterisk in Table 2) must of necessity include Washington and South Carolina, home of the Hanford and Savannah River military reactors. Emissions from these reactors are not reported by Brookhaven, and cannot be assumed to have reached peak levels in the late seventies as is the case of civilian power reactors. Again, Brookhaven does not report on emissions from the hundreds of small experimental reactors located at research institutes, universities, and large hospitals. Most of these can be found in the states designated in Table 2 as *nuclear*

The years 1965–69 were chosen as the most suitable control time period—radiation from bomb test fallout was at very low levels. Both Nevada and Utah, which have no nuclear reactors, were included in our *nonnuclear* states. Some residents of both these states, however, might have been affected by occasional accidental emissions from underground tests in the Nevada desert. These tests continued without interruption after the atmospheric test ban in 1963. In fact, these tests are continued today with as yet unknown public health consequences.

TABLE 3: SUMMARY OF CHANGES IN MORTALITY RATES, 1965–69, 1975–82, US, NUCLEAR AND NON-NUCLEAR STATES

	US	NUCLEAR STATES	NON-NUCLEAR STATES
1965–69			
Total # Infant Deaths	401995	310289	91706
Total # Live Births	17858535	13989682	3868853
Average Annual IMR (Deaths Per 1000 Live Births)	22.510	22.180	23.704
Total # of Deaths	9351192	7467466	1883726
Average Annual Population	196844	155742	41103
Average Annual Mortality Rate (Deaths Per 100,000)	950.11	958.96	916.60
Total # Cancer Deaths	1549534	1256809	292725
Average Annual Cancer Rate (Deaths Per 100,000)	157.44	161.40	142.44
1975–82			
Total # Infant Deaths	364490	270823	93667
Total # Live Births	27155479	20187695	6967784
Average Annual IMR (Deaths Per 1000 Live Births)	13.422	13.415	13.443
Total # of Deaths	15449794	12157892	3291902
Average Annual Population	222093	172840	49253
Average Annual Mortality Rate (Deaths Per 100,000)	869.56	879.27	835.45
Total # Cancer Deaths	3192087	2561141	630946
Average Annual Cancer Rate (Deaths Per 100,000)	179.66	185.22	160.13
Ratios of Change, 1975–82/1965–69			
Infant Mortality Rate	0.5963	0.6048	0.5671
Total Mortality Rate	0.9152	0.9169	0.9115
Cancer Mortality Rate	1.1411	1.1476	1.1242
Annual Percent Rates of Change			
Infant Mortality Rate	−4.04	−3.95	−4.33
Total Mortality Rate	−0.85	−0.83	−0.89
Cancer Mortality Rate	1.41	1.48	1.24

The average annual mortality rates have been calculated in both time periods for these two groups of states. The results are summarized in Tables 3 and 4. The tables suggest that emissions from nuclear reactors in the *nuclear* states may have had a small but statistically significant adverse impact on mortality rates in the 1975–1982 period, when such emissions reached high levels.

Thus, according to Table 3, which summarizes the rate in the *nuclear* and *nonnuclear* states, the infant mortality rate in the *nuclear* states was 22.2 per thousand births in the 1965–69 period, somewhat lower than the national IMR in those years of 22.5 (not a statistically significant difference). In that same period, however, the IMR for *nonnuclear* states was much higher than the *nuclear* IMR, but ended somewhat lower in the later period. Its decline, over these years, was at the annual rate of 0.89 percent, as against 0.83 percent for the *nuclear* states.

While these differences appear small, in Table 4 they translate into disturbingly large annual estimates of *excess* deaths. This calculation yields what the observed deaths would have been in the *nuclear* states if they had had the same percentage change in mortality rates experienced by the *nonnuclear* states.

A surprisingly similar difference is arrived at between the two groups of states with respect to cancer mortality. While the cancer mortality rate in the *nuclear* states was somewhat below that of the nation in the early period, it was considerably higher in the later period.

At first glance, this appears surprising because we would expect at least a five-year lag of cancer mortality from the year of exposure, suggesting that emissions in the 1974–81 period should lead to elevated cancer mortality levels in the eighties and nineties. The elevated cancer rates in the late seventies may reflect the much higher but earlier and yet unknown emission levels from military reactors. They may also reflect the emissions from some civilian reactors in the 1970–74 years.

Indeed the impact on public health of military reactor emissions deserves separate study (See front page box) both because the time period of operation spans several decades, and because the cumulated volume of emissions may be higher than that of civilian reactors. However, so much is *not* known about the treatment and disposal of the huge stockpiles of military waste, we must

assume that the associated public health problems may be of the same order of magnitude as those of the civilian reactors.

Unlike infant and total mortality rates that are steadily declining, cancer mortality rates have been rising for several decades. The causes of this increase involve a complex mix of environmental and demographic factors for which total cancer mortality rates, unadjusted for sex, race, or age, require considerable further research.

Differences in Mortality

What do these results signify? First, the small differences between the mortality changes of the two groups of states *cannot* be attributed to chance. On the other hand, can these differences be attributed to different nuclear emissions levels? There is no clearly defined tendency evident in Table 2 among *each* of the so-called *nuclear* states to have increases in mortality that exceed those of the nation. This becomes evident by considering the ratios of change for each state for the three different mortality rates shown in Table 2. It can be said that a state does *worse* than the nation if the decline in its infant or total mortality rate was less than that of the nation or if the gain in its cancer mortality rates was greater than that of the nation. Thus, the 30 *nuclear* states have 90 opportunities to be measured against the national performance, and the 19 *nonnuclear* states have 57 such opportunities. (As examples, the *nuclear* state of Connecticut performed *worse* than the nation with respect to all three mortality rates, and the *nonnuclear* state of Wyoming performed *better* on all three counts.)

But the *nonnuclear* states can be seen to do *better* than the nation in only 54 percent of all cases, and the *nuclear* states do *better* in about 52 percent of all cases. Thus, it cannot be said that *nonnuclear* states have a tendency to perform significantly *better* than *nuclear* states. How can these apparently contradictory results be reconciled with the results of Tables 3 and 4? Can it be that the statistically significant differences between the two groups of states shown by Table 3 reflect factors other than nuclear emissions? There is a simple explanation of this paradox.

There are a total of about 90 civilian and military reactors that released emissions of varying volumes in the most recent time period. The effects of these emissions will be primarily found in residents of those relatively few counties most directly impacted by the releases. The vital statistics for these counties should then show up in these counties and not in the far more numerous remaining counties that make up the United States.

TABLE 4: CALCULATION OF ANNUAL EXCESS MORTALITY IN NUCLEAR STATES 1975–82

	NUCLEAR STATES	NON-NUCLEAR STATES
1965–69		
Average Annual IMR (Deaths Per 1000 Live Births)	22.18	23.70
Average Annual Mortality Rate (Deaths Per 100,000)	958.96	916.60
Average Annual Cancer Rate (Deaths Per 100,000)	161.40	142.44
1975–82		
Average Annual IMR (Deaths Per 1000 Live Births)	12.58	13.44
Average Annual Mortality Rate (Deaths Per 100,000)	874.09	835.45
Average Annual Cancer Rate (Deaths Per 100,000)	181.45	160.10
Actual Avg. Annual Infant Deaths	33853	11708
Actual Avg. Annual Live Births	2523462	870973
Actual Avg. Annual Deaths	1519737	411488
Actual Avg. Annual Population	172840	49253
Actual Avg. Annual Cancer Deaths	320143	78868
Estimated Avg. Annual Infant Deaths	31740	—
Estimated Avg. Annual Deaths	1510780	—
Estimated Avg. Annual Cancer Deaths	313611	
Excess Annual Infant Deaths	2113	—
Excess Annual Total Deaths	8957	—
Excess Annual Cancer Deaths	6532	—

In this table we have calculated the "excess" in mortality in the nuclear states as the difference in the number of expected deaths if these states had the same change in mortality since 1965-69 as was experienced by the nonnuclear states. These calculations are warranted by the fact that this assumption yields differences that are highly unlikely to be attributed to chance. The standard deviation (σ) of the difference between the observed mortality rate and an expected rate is given by the formula:

$$\sigma_{r_o - r_e} = \sqrt{\frac{(r_o)(1-r_o)}{N} + \frac{(r_e)(1-r_e)}{N}}$$

where r_o and r_e are the observed and expected mortality rates expressed to six decimals on a per capita basis, and N represents the number of deaths in the 1975-82 period. The results can be tabulated as follows

	IMR	CMR	TMR
1 r_o	01342	001852	.008793
2 r_e	.01258	001814	008741
3 $r_o - r_e$	.00084	000038	000052
4 $\sigma_{r_o - r_e}$	00031	000037	000037
5 Line 3/Line 4	2 72	1 01	1 38
6. Chance Probability	.004	156	084

Line 6 indicates the probabilities of securing the observed difference on line 3 purely by chance. The difference in infant mortality rates is most significant, for the probability of getting as large a difference as was observed is only four out of 1000. (A probability ratio of 50 times out of 1000 is generally taken as indicative of a highly improbable result of chance.) The observed difference in cancer mortality rates lies at the borderline of chance. The probability that both the observed differences in the infant and cancer mortality could simultaneously be the result of chance could be calculated by multiplying .004 by .156 to yield .0006, because these two mortality rates are completely independent. The p value for total mortality—.084—lies at the borderline of chance probability, but since total mortality includes both infant and cancer deaths (with a joint p of only .0006), it is hard to believe that all other deaths would not be affected by the same extra force of mortality that affected infants and cancer victims.

We do not have emissions data as yet for military reactors, which, in any case, were in continuous operation in both the two time periods we are considering. We can, however, attempt to de-

Continued page 6

fine a *nuclear* county for the 50 civilian power reactors for which we do have emissions data for recent years.

Some 175 counties have been chosen as a first step to defining a *nuclear* county, one that would be more directly exposed to recent radioactive emissions from civilian reactors. These include, in addition to the county in which the reactor is located, an average of two or three counties lying within 25 or 30 miles from the reactor. Those adjacent counties lying to the north and east are favored in accordance with the prevailing wind patterns in the US. (For example, it has been suggested that such wind patterns account for the severity of acid rain in the Northeastern region of the US.)

This too is a highly simplistic definition. Windborne emissions by no means represent the most important way in which nearby residents can be affected. For example, rainfall affecting adjacent counties probably determines the ulti-

TABLE 5: NUCLEAR COUNTIES: SUMMARY OF CHANGES IN PUBLIC HEALTH MEASURES, 1965-69 AND 1975-82

	NUCLEAR COUNTIES				
	BOILING WATER REACTORS	PRESSURIZED WATER REACTORS	ALL REACTORS COUNTIES	NONNUCLEAR COUNTIES	US TOTALS
1965-69					
Number of Counties	71	114	175	2968	3143
Number of Births	1325248	1498874	2730406	15258955	17989361
Number of Infant Deaths	30524	32060	60723	348023	408746
IMR (Deaths per 1000 Births)	23.0	21.4	22.2	22.8	22.7
Number of Fetal Deaths	19165	21256	39226	239246	278472
FMR (Deaths per 1000 Births)	14.5	14.2	14.4	15.7	15.5
Population, 1970	14552937	17508052	31072244	172232619	203304863
Number of Deaths	693005	737496	1387843	8006837	9394680
MR (Deaths per 1000 Persons)	9.5	8.4	8.9	9.3	9.2
Number of Cancer Deaths	117589	126722	237103	1316843	1553946
CMR (Deaths per 100,000 Persons)	161.6	144.8	152.6	152.9	152.9
1975-82					
Th. Curies Emitted, 1974-81	2.37E+07	1.17E+07	3.54E+07		
Emission Per Capita	1.583	0.577	1.035		
Number of Births	1809882	2305116	3975794	23412534	27388328
Number of Infant Deaths	26331	29542	54210	314397	368607
IMR (Deaths per 1000 Births)	14.5	12.8	13.6	13.4	13.5
*Number of Births	1572114	1987858	3439066	20268725	23707791
*Number of Fetal Deaths	15645	18412	33071	198107	231178
*FMR (Deaths per 1000 Births)	10.0	9.3	9.6	9.8	9.8
Population, 1980	14975515	20292643	34186432	192359373	226545805
Number of Deaths	1037764	1331493	2300973	13185191	15486164
MR (Deaths per 1000 Persons)	8.7	8.2	8.4	8.6	8.5
Number of Cancer Deaths	220776	289143	495352	2707124	3202476
CMR (Deaths per 100,000 Persons)	184.3	178.1	181.1	175.9	176.7
RATIOS OF CHANGE					
IMR	0.632	0.599	0.613	0.589	0.592
FMR	0.687	0.653	0.669	0.623	0.630
MR	0.910	0.974	0.942	0.922	0.925
CMR	1.140	1.230	1.187	1.150	1.156

*Fetal Death data relates to the period 1975-81. As of this writing, 1982 data are unavailable

mate destination of most emitted radioactive particulates and effluents. Nearby residents can also be affected by the possible contamination of water, milk, and produce from counties even further removed from the point source of the emissions. Each reactor represents a unique geographic situation that deserves a careful examination of wind, precipitation and fresh food transportation patterns. This examination will offer a more complete definition of those adjacent counties vulnerable to local emissions.

Nevertheless, it turns out that even with the admittedly restricted definition of the 175 nuclear counties used here, results indicate adverse impacts on measures of infant mortality, fetal mortality, total mortality, and cancer mortality in the late seventies as compared with the earlier period. These results are summarized in Table 5 which replicates the methodology of Table 3. Now, however, the change in mortality rates of *nuclear* counties are compared with *nonnuclear* counties.

In addition, the nuclear counties are separated into two groups: those close to boiling water reactors and those close to pressurized water reactors. For all *nuclear and nonnuclear* counties, the rates for infant, fetal, and total mortality are seen to decline over the selected time period. It will be seen, however, that the declines in *nuclear* counties in each case fell short of the declines in *nonnuclear* counties. With respect to cancer mortality, which has been rising over these years, the 19 percent gain in *nuclear* counties exceeded the 15 percent gain in *nonnuclear* counties.

Could such results be the product of chance? If the answer is yes, then we would expect a 50 percent probability for each change in mortality in *nuclear* counties to be worse than the change in *nonnuclear* counties. The chance of then getting four such results at the same time would be equal to a coin tosser getting four heads in a row, i.e., $(.50)^4 = .0525$, or about one in twenty. Actually, the probability of obtaining all four observed changes in mortality rates by chance is less than 2 out of 100 as evident in the caption to Table 6.

Given the fact (demonstrated in the caption to Table 6) that the difference in the mortality experience of the two groups of counties is significant, we can speculate that there may be two ways to increase the statistical significance of our findings. The time periods studied should be extended and additional *nuclear* counties included. Extending the definition of *nuclear* counties possibly affected by radioactive rainfall might, for example, double the number of deaths involved. If the divergence between observed and expected rates remained the same, the significance of the results would be increased by 40 percent (i.e., by $\sqrt{2}$).

TABLE 6: THE STATISTICAL SIGNIFICANCE OF CHANGING MORTALITY RATES

	IMR	FMR	TMR	CMR
1. Mortality Rate, Nuclear Counties 1965–69	0.02224	0.014366	0.008933	0.001526
2. Ratio of Change in Nonnuclear Counties	0.5888	0.6234	0.9215	1.1504
3. Expected Mortality Rate, Nuclear Counties, 1975–82 (1 × 2)	0.013095	0.008956	0.008232	0.001756
4. Observed Mortality Rate, Nuclear Counties, 1975–82	0.013635	0.009616	0.008413	0.001811
5. Difference (4–3)	0.000540	0.000660	0.000181	0.000055
6. Standard Deviation of the Difference	0.000697	0.000745	0.000084	0.000084
7. 5/6	0.77	0.89	2.14	0.65
8. Chance Probability	0.2207	0.1867	0.0162	0.2579

In this table, we are testing the differences between a mortality rate registered in the combined group of 175 nuclear *counties in 1975–82 with what would have been expected if these counties had the same change in mortality experienced by all the* nonnuclear *counties. We know from Table 5 that these counties had a somewhat better performance with respect to all four mortality rates.*

For the sake of precision, we have expressed all rates on a per-capita basis to six decimals. For example the IMR of the nuclear *counties would have been .013095 instead of .013635 if its 1965–69 rate had undergone the same ratio of change (.5888) reported for the* nonnuclear *counties. Is the difference between this "expected" rate and the observed actual rate (.000540) significant? The answer is given by the formula for the standard deviation (σ) of the difference between two sample rates:*

$$\sigma_{r_1 - r_2} = \sqrt{\frac{(r_1)(1-r_1)}{n} + \frac{(r_2)(1-r_2)}{n}}$$

where r_2 is the expected rate, r_1 is the observed rate, and n is the number of deaths involved in the calculation of the mortality rate.

We see from rows 6, 7 and 8 above that the probability of securing by chance alone a divergence between the expected and observed IMR as great or greater than .000540 is about 22 percent. By itself, this cannot be regarded as a significant divergence. Similarly, the "chance" probabilities of securing the observed divergences in the fetal and cancer mortality rates are respectively 19 percent and 26 percent, each being high enough to be regarded as the possible product of chance. But since each of these three rates are completely independent, we can ask what is the probability that all three divergences are simultaneously the product of chance? The answer, given by multiplying the three independent probabilities is .0106, which is about one chance in one hundred.

This is in agreement with the very low chance probability (.0162) of securing the observed divergence in the total mortality rate, which of course includes infant, fetal, and cancer deaths. Thus, we have two pieces of evidence to suggest that there are less than two chances out of one hundred for the following statement to be false: In the period 1975–82 there was some extra force of mortality present in the nuclear *counties not operating in the* nonnuclear *counties.*

If the more current experience in the eighties is included, more significant divergences in the cancer rates can be expected. Based on only a few years in the early seventies, the cancer rate divergence in Table 6 is seen to be the least significant. If nuclear emissions in the seventies do result in elevated cancer rates, such effects will more likely be seen in the next twenty years.

A more detailed, properly financed study would, of course, try to account for other environmental factors and allow for adjustments for changes in age, sex, and race required by proper biostatistical procedures. These results, in CEP's opinion, would illuminate the main thrust of these findings.

It is clear that emissions in the *nuclear* counties have had an adverse impact on mortality, particularly on the very young and very old. It will be noted that the total mortality rate (TMR) registered in the *nuclear* counties had the smallest likelihood of being due to chance. This rate mainly reflects the deaths of persons over 65 years of age. But infant and fetal deaths are almost

Continued page 9

TABLE 7: REACTORS AND LOCATIONS

REACTOR	B/P	TOTAL EMISSIONS 1974-81	LOCATION	COUNTIES INCLUDED
Big Rock Point	B	3.34E+05	4 miles NE of Charlevoix, MI	MI: Charlevoix, Cheboygan, Emmett
Brown's Ferry	B	1.04E+06	10 miles NW of Decatur, AL	AL: Lawrence, Madison, Morgan TN: Franklin, Lincoln
Brunswick	B	1.06E+06	20 miles S of Wilmington, NC	NC: Duplin, New Hanover, Onslow, Pender
Cooper	B	1.03E+05	70 miles S of Omaha, NB	IA: Fremont, Mills NB: Cass, *Douglas, Lancaster, *Sarpy, *Washington
Dresden 1, 2 & 3	B	3.97E+06	14 miles SW of Joliet, IL	IL: Cook, DuPage, Kendall, Will IN: Lake
Duane Arnold	B	2.42E+04	8 miles NW of Cedar Rapids, IA	IA: Benton, Buchanan, Delaware, Dubuque, Linn
Edwin I. Hatch 1 & 2	B	7.47E+04	11 miles N of Baxley, GA	GA: Appling, Candler, Tatnall, Toombs
Humboldt Bay	B	9.62E+05	4 miles SW of Eureka, CA	CA: Del Norte, Humboldt, Siskiyou, Trinity
James A. Fitzpatrick	B	3.58E+05	36 miles N of Syracuse, NY	NY: Jefferson, *Oswego, St. Laurence
La Crosse	B	3.01E+05	19 miles S of La Crosse, WI	WI: Buffalo, Jackson, La Crosse, Monroe, Trempealeau
Millstone #1 & 2	B/P	5.63E+06	3.2 miles WSW New London, CT	CT: New London RI: Kent, Providence, Washington
Monticello	B	1.76E+06	23 miles SE of St. Cloud, MN	MN: Benton, Isanti, Morrison, Sherborne
Nine Mile Point	B	2.04E+06	8 miles NE of Oswego, NY	NY: Lewis, *Oswego
Oyster Creek	B	2.92E+06	9 miles S of Toms River, NJ	NJ: Middlesex, Monmouth
Peach Bottom	B	5.53E+05	17.9 miles S of Lancaster, PA	PA: Berkes, Lancaster, *Lebanon
Pilgrim	B	1.27E+06	25 miles SE of Boston, MA	MA: Norfolk, Suffolk
Quad Cities	B	1.24E+06	20 miles NE of Moline, IL	IL: Carroll, Whiteside IA: Clinton
Vermont Yankee	B	9.23E+04	5 miles S of Brattleboro, VT	NH: Cheshire, Sullivan VT: Windham
Fort St. Vrain	B	2.28E+02	35 miles N of Denver, CO	CO: Adams, Boulder, Denver
Arkansas 1 & 2	P	9.68E+04	6 miles WNW Russellville, AR	AR: Conway, Johnson, Newton, Pope, Van Buren
Beaver Valley	P	3.08E+03	Shippingport, PA	PA: Beaver, Butler, Lawrence
Calvert Cliffs	P	8.24E+04	45 miles SE of Washington, DC	MD: Calvert, Charles, Dorchester, Prince Georges, St. Marys Talbot
Crystal River	P	1.59E+05	70 miles N of Tampa, FL	FL: Alachua, Gilchrist, Marion, Putnam
Davis Besse	P	9.41E+03	21 miles E of Toledo, OH	MI: Monroe OH: Lucas, Ottowa
Donald C. Cook	P	7.34E+04	11 miles SSW of St. Joseph, MI	IN: La Porte, St. Joseph MI: Berrien, *Van Buren
Fort Calhoun	P	1.01E+04	19 miles N of Omaha, NB	IA: Harrison, Pottawattamie NB: *Douglas, *Sarpy, Saunders, *Washington
H.B. Robinson	P	8.10E+03	4.5 miles NNW of Hartsville, SC	NC: Anson SC: Chesterfield, Darlington, Marlboro
Haddam Neck	P	1.62E+04	10 miles SE of Middletown, CT	CT: Middlesex
Indian Point 1, 2 & 3	P	9.18E+04	3 miles SW of Peekskill, NY	NY: Rockland, Westchester
Joseph M. Farley	P	2.61E+04	Dothan, AL	AL: Barbour, Geneva, Henry, Houston GA: Early
Kewaunee	P	1.05E+04	27 miles ESE of Green Bay, WI	WI: *Brown, Door, *Kewaunee
Maine Yankee	P	1.96E+04	3.9 miles S of Wicassett, ME	ME: Kennebec, Knox, Lincoln, Waldo
McGuire	P	0.00E+00	17 miles N of Charlotte, NC	NC: Cabarrus, Catawaba, Gaston, Mecklenberg, Rowan, Union SC: York
North Anna	P	3.02E+04	40 miles NW of Richmond, VA	VA: Caroline, Hanover, Henrico, King William
Oconee	P	2.41E+05	30 miles W of Greenville, SC	SC: Greenville, Oconee, Pickens
Palisades	P	6.23E+03	5 miles S of South Haven, MI	MI: Allegan, Cass, Kalamazoo, *Van Buren
Point Beach	P	5.94E+04	15 miles N of Manitowoc, WI	WI: *Brown, *Kewaunee, Manitowac
Prairie Island	P	7.21E+03	26 miles SE of Minneapolis, MN	MN: Dakota, Goodhue, Hennepin, Ramsey, Scott, Washington WI: Pierce, St. Croix
R.E. Ginna	P	2.30E+04	16 miles NE of Rochester, NY	NY: Monroe, Wayne
Rancho Seco	P	2.11E+04	25 miles SE of Sacramento, CA	CA: Amador, El Dorado, Sacramento
Salem 1, 2	P	2.03E+03	20 miles S of Wilmington, DE	DE: New Castle NJ: Cumberland, Salem
San Onofre	P	7.37E+03	2.5 miles S of San Clemente, CA	CA: Orange, Riverside
Sequoyah	P	1.20E+04	Daisy, TN	TN: Hamilton, Meigs, Rhea
St. Lucie	P	1.04E+05	8 miles S of Ft. Pierce, FL	FL: Indian River, Okeechobee, St. Lucie
Surry	P	7.94E+04	19 miles NW of Newport News, VA	VA: Charles City, Surry, York
Three Mile Island 1,2	P	1.01E+07	10 miles SE of Harrisburg, PA	PA: Schuykill, Dauphin, *Lebanon, Northumberland
Trojan	P	6.52E+03	35 miles NW of Portland, OR	OR: Columbia, Multanomah WA: Clark, Cowlitz
Turkey Point	P	9.96E+04	10 miles E of Florida City, FL	FL: Broward, Dade
Yankee Rowe	P	1.29E+03	20 miles NW of Greenfield, MA	MA: Franklin NH: *Cheshire VT: *Windham
Zion	P	3.12E+05	6 miles N of Waukegan, IL	IL: Lake WI: Kenosha, Racine

*Counties close to more than one reactor.

Council on Economic Priorities
NEWSLETTER

Editor-in-chief: Alice Tepper Marlin **Editor:** Paula Lippin

The Council on Economic Priorities is a non-profit organization established to disseminate unbiased and detailed information on the practices of U.S. corporations. These practices have a profound impact on the quality of American life. CEP was established so that the American public could become aware of this impact and work to ensure corporate social responsibility. CEP publishes 3-6 **Studies** and/or **Reports** per year, and a **Monthly Newsletter**. Memberships and contributions are tax-deductible. Indexed in Public Affairs Information Service Bulletin. Excerpts welcomed. Please credit the Council on Economic Priorities, 30 Irving Place, New York, New York 10003, and send us a copy.

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For Further Reading

Quality Of Life In American Neighborhoods: Levels of Affluence, Toxic Waste and Cancer Mortality In Residential Zip Code Areas. Jay M. Gould, Westview Press, 1986. See also CEP Newsletters "Toxic Waste and Cancer: The Link is Getting Stronger," Sept. 1984; "Freedom of Information Act: Breaking the Federal Barrier," June 1985; "Toxic Waste in Chesapeake Bay: Bad for People as Well as for Fish," Nov. 1985.

Maternal and Child Health Data Book, Children's Defense Fund, Washington, D.C. 1986.

Radioactive Materials Released From Nuclear Power Plants, 1981, J. Tichler and C. Benkovitz, Brookhaven National Laboratory, 1984.

Measurement of Low Levels of X-ray Mutagenesis in Relation to Human Disease, C. Waldren, L. Correll, M.A. Sognier, T.T. Puck, July, 1986, Proc. U.S. Natl Academy of Science. The data obtained by these investigators, using a new laboratory technique involving individual human chromosones implanted in animal cells, show that the effect of low dose radiation exposures is more than 200 times greater than had previously been assumed on the basis of high dose studies.

This is a part of a rapidly growing body of clinical literature on ionizing radiation effects which can be secured from the **Health and Energy Institute** in Washington, D.C. The detailed annual mortality date for the 175 counties studied here can be obtained on a personal computer diskette from Public Data Access Inc., 30 Irving Place, New York, NY 10003. (212-529-0890). PDA can assemble diskettes with mortality rates for any desired group of states or counties in great detail, and in any desired mode, such as Wordstar, Lotus, or D-Base III.

immediately responsive to the lethal effects of radioactive iodine included in the emissions. Table 5 shows that the greatest adverse change in the infant and fetal mortality rates was registered by those counties close to boiling water reactors. These counties had emission rates of 1.6 curies per capita as against 0.6 curies per capita for the pressurized water reactor counties in the 1975–82 period.

There is little point at this early stage in the investigation to attempt to quantify the extent of the adverse impact since we do not yet have a satisfactory delineation of all the *nuclear* counties affected by both civilian and military reactors. In Table 7, the 175 counties adjacent to each civilian reactor which we have chosen as *nuclear* counties for this Newsletter are listed. Almost certainly, there are several hundred more that could be included among those directly or indirectly affected by emissions from both civilian and military reactors. It is CEP's hope that environmental organizations around each reactor will, on reading this Newsletter, share with us their knowledge or even suspicions about those counties omitted from our preliminary definitions. By adding counties with a lesser impact, the average divergence in mortality rates from those in *nonnuclear* areas will be narrowed. The additional deaths, however, will make our findings more significant statistically and can lead to a more precise quantification of the number of excess deaths to be attributed to emissions. Until then, the estimate of an excess 9000 deaths per year derived from this analysis of *nuclear* states can stand as a preliminary overall estimate.

It is also clear that CEP's estimates of the public health impact of radioactivity and other environmental abuses such as toxic waste can be made far more precise by allowing for differences due to age, sex, and race. Computer tapes from the National Center for Health Statistics are now in CEP's possession. From these tapes, the mortality rates for each county, since 1968, for all white and nonwhite males and females, by age group and for several hundred detailed causes of death can be calculated. Use of this extraordinary database, a tribute to the work of statisticians and epidemiologists of the National Center, will make it possible to pinpoint those groups in our population bearing the brunt of the loss of lives from all environmental abuses. ■

(Appendix D)

Letters to the Editor

CANCER NEAR NUCLEAR INSTALLATIONS

SIR,—Comprehensive information on the frequency of cancer in local authority areas in the vicinity of fifteen nuclear installations in England and Wales has recently been made available to the public.[1] As you say in your note last week (Feb 28, p 520) of particular interest is the incidence of leukaemia in 0–24-year-olds, since an excess incidence has been found near Sellafield in west Cumbria[2] and near Dounreay.[3]

STANDARDISED INCIDENCE AND MORTALITY RATIOS FOR LEUKAEMIA AND ALL CANCERS IN PERSONS AGED 0–24 YEARS IN LOCAL AUTHORITY AREAS IN ENGLAND AND WALES WITH AT LEAST ONE-THIRD OF THEIR POPULATION LIVING WITHIN 10 MILES OF NUCLEAR INSTALLATIONS INCLUDED IN OPCS REPORT (EXCEPT SELLAFIELD) AND IN CONTROL AREAS FROM TABLE 2 IN OPCS REPORT

—	Standardised ratio (and number of cases) for years:				
	1959–65†	1966–70	1971–75	1976–80	All
Incidence					
Leukaemia					
All installations‡	107 (*111*)	104 (*124*)	112 (*157*)	118* (*164*)	111* (*556*)
Control areas	89 (*94*)	89 (*109*)	104 (*148*)	97 (*150*)	97 (*501*)
All cancers					
All installations	106 (*511*)	103 (*617*)	110* (*639*)	112** (*671*)	108** (*2438*)
Control areas	95 (*466*)	102 (*622*)	100 (*598*)	103 (*636*)	100 (*2322*)
Mortality					
Leukaemia					
All installations	94 (*160*)	108 (*134*)	111 (*126*)	96 (*98*)	102 (*518*)
Control areas	112 (*194*)	90 (*114*)	114 (*131*)	105 (*110*)	106 (*549*)
All cancers					
All installations	97 (*454*)	98 (*342*)	101 (*338*)	100 (*294*)	99 (*1428*)
Control areas	95 (*470*)	97 (*343*)	101 (*344*)	97 (*292*)	98 (*1449*)

*$p < 0·05$, ** $p < 0·01$ †1961–64 for incidence data. ‡All except Sellafield.

The accompanying table shows for all the installations included in the OPCS report, except Sellafield, and for corresponding control areas the total incidence and mortality ratios for leukaemia and all cancers at age 0–24 years. The figures include the four time periods for which data were provided and all the areas selected by OPCS for study. Over the whole study period there is a significant excess incidence of leukaemia and of all cancers in areas in the vicinity of the installations, but not in the control areas. The exclusion of leukaemia from the all-cancer incidence figures for the installations leaves a significantly increased ratio of 107, based on 1882 registrations. Considering each time period separately, leukaemia incidence is significantly raised only in 1976–80, and the all-cancer incidence in 1971–75 and 1976–80. The number of cancers near any one installation is generally small and no installation can be singled out as differing significantly from the others. In contrast to the incidence data, none of the mortality ratios differs significantly from 100.

The discrepancy between the incidence and mortality findings is important, and the reasons for it will need to be clarified. Some possibilities include: cancer registration might be more complete or cancer survival better in the vicinity of nuclear establishments than elsewhere; there might be differential migration away from nuclear installations once a child is diagnosed as having cancer; or the increase in cancer incidence might be too recent to be reflected in mortality statistics. To establish which, if any, of these possible explanations is valid will require detailed investigation.

The estimated magnitude of the overall risk is not large—an 11% excess for leukaemia incidence and an 8% excess for all-cancer incidence. These figures apply to people living within roughly a 10 mile (16 km) radius of the installations. The OPCS data provide only crude information on the relation between risk and distance from the installations. This is because the smallest geographical unit studied was the local authority area, whose breadth is often more than 10 miles, especially in the rural districts where most nuclear installations are located. For detailed assessment of risk in relation to distance from the installations it will be necessary to study smaller geographical areas, as has been done elsewhere.[3,4]

The data in this report do not go beyond 1980, yet statistics for later years should now be available. It is important to know whether the findings noted here persist.

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VALERIE BERAL

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(Appendix E)

SUMMARY OF ENVIRONMENTAL HEALTH EFFECTS
FROM NUCLEAR PLANTS

	Leukemia	Other Cancer	Infant Mortality	Fetal Mortality	Congenital Defects	Down Wind or Coastal
Windscale, England	Y			N	?	Y
3 coastal Scotland	Y				?	Y
San Onofre Calif.	N?	N?	N?			N
Rocky Flats Colorado	Y	Y	Y?	Y?	Y	Y
Hanford Wash.			N?	Y?		Y
T.M.I. Penna.		?	Y?	Y	Y?	Y
All Plants Wisconsin			Y			Y
Yankee Maine	Y					Y
Pilgrim I Mass.	Y					Y

Prepared 7/30/86 by Sidney Cobb MD, Prof Emeritus of Community Health in Brown University Program in Medicine. The opinions expressed are his not necessarily those of the original authors. No claim to completeness is made.

The tentative conclusion is that where there is so much smoke there must be some fire. In other words it now seems quite likely that there is some hazard to human health from living down wind of some nuclear plants. To determine just how much of what conditions and under what circumstances is the research task for the future.

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(Appendix F)

Statement of Commissioner James K. Asselstine
U.S. Nuclear Regulatory Commission

before the

Subcommittee on Energy Conservation and Power
Committee on Energy and Commerce
May 22, 1986

Mr. Chairman, I disagree in many respects with the Commission's testimony on the impact of the Chernobyl accident. Now that the Chernobyl accident has turned the spotlight onto the safety of the U.S. nuclear power reactors, the Commission would have the Congress and the public believe that the U.S. plants may be five times safer than estimated just a few months ago, that the U.S. plants are far safer than the Commission's provisional safety goals, that the U.S. plants are much safer than believed when the Commission deemed the severe accident risks to be acceptable last year, and that the consequences of a core meltdown in the U.S. are "very different" than the consequences of a core meltdown in the Soviet Union. Indeed, the Commission now seems to believe that the TMI inspired backfits, which many argued before Chernobyl to have questionable if not negative impacts on safety, have turned out to be very positive contributors to safety. Before Chernobyl, those "undisciplined" TMI backfits served as part of the basis for the promulgation of the Commission's backfit rule, which erects a substantial barrier against efforts to improve safety. After Chernobyl, the Commission and the nuclear industry find that those TMI backfits have provided substantial improvements in safety. Finally, according to the Commission, apart from finding that the light water reactors in the U.S. cannot have large graphite fires, it is premature to

draw conclusions regarding the ramifications of the Chernobyl accident for our nuclear power program.

Mr. Chairman, by focusing on the design differences between the Soviet plants and U.S. plants, the Commission misses the broader lessons of the Chernobyl accident for nuclear safety in the United States. Those broader lessons have to do with the acceptability of core meltdown accidents and the adequacy of our current efforts to prevent such accidents and to minimize their consequences should one occur. I want to start with what I think are three inescapable conclusions regarding the risk of core meltdown accidents in the United States.

First, unless further steps are taken to reduce substantially the likelihood of a core meltdown accident, we can expect to see such an accident at a U.S. plant within the next 20 years. This conclusion is supported by the probabilistic risk assessments done for U.S. plants to date, by the substantial uncertainties in those assessments, including their limited ability to account for human performance and external accident initiators, and by recent operating experience with the plants which shows that at least some PRA assumptions are overly optimistic. As the Commission's chief safety officer noted recently, serious operating events illustrate that in the real world, system and component reliabilities can degrade below those we and the industry routinely assume in estimating core melt frequencies.

2)

Second, as is apparently the case with the Soviet reactors, our reactors were not designed for large-scale core meltdown accidents. Because such accidents were assumed to be so unlikely as to be incredible, they were judged to be outside of the design basis for the plants. One consequence of this assumption is that U.S. reactor containments were designed to withstand the rupture of a large steam pipe but were not designed to withstand large-scale core meltdowns.

Third, although we believe that all of our reactors have some capability to withstand severe core meltdown accidents, the extent to which they can withstand such accidents depends upon the sequence of events during the accident, the individual plant designs and the manner in which each plant is operated and maintained. While we hope that their occurrence is unlikely, there are accident sequences for U.S. plants that can lead to rupture or bypassing of the containment in U.S. reactors which would result in the off-site release of fission products comparable to or worse than the releases estimated by the NRC staff to have taken place during the Chernobyl accident. That is why the Commission told the Congress recently that it could not rule out a commercial nuclear power plant accident in the United States resulting in tens of billions of dollars in property losses and injuries to the public. The bottom line is that, given the present level of safety being achieved by the operating nuclear power plants in this country, we can expect to see a core meltdown accident within the next 20 years and it is possible that such an accident could result in off-site releases of radiation which are as large as, or larger than, the releases estimated to have occurred at Chernobyl.

My point is that large power reactors, in this country and abroad, are not inherently safe. Each design has its own core meltdown vulnerabilities. If nothing else Chernobyl should remind all of us that core meltdown accidents can happen and, even assuming evacuation is successful, that the resulting releases can leave large tracts of land and buildings highly contaminated.

To me, the lessons of Chernobyl are simple and straightforward. Given the uncertainties in containment and plant performance, the occurrence of a severe core meltdown accident over the next 20 years is unacceptable. That was the judgment of the President's Commission on the Three Mile Island Accident six years ago, and it is no less true today. We should return to the safety philosophy espoused by the Kemeny Commission at that time -- to pursue all practical measures both to prevent core meltdown accidents from occurring and to minimize their consequences should one occur. This safety philosophy is fundamentally at odds with the Commission's decision in the Indian Point Special Proceeding, with the Severe Accident Policy Statement, with the Commission's backfit rule and with the Commission's provisional safety goal. It is also at odds with the passion for deregulation that has been sweeping the nuclear industry and the Commission over the past two years.

Many other countries have and are taking U.S.-developed technology and minimum safety standards, and building on them to have better nuclear plants with greater defense-in-depth than that being achieved in this country. These other countries have better designed plants that are

operated and maintained better than the U.S. plants and that are safer than the U.S. plants. They have achieved a far better state of affairs with respect to reliability and safety of their plants than this country has. And, they have accomplished this in a disciplined manner at reasonable costs. While we are looking at foreign safety experience in the aftermath of the Chernobyl accident, we should consider following their example.

Thank you.

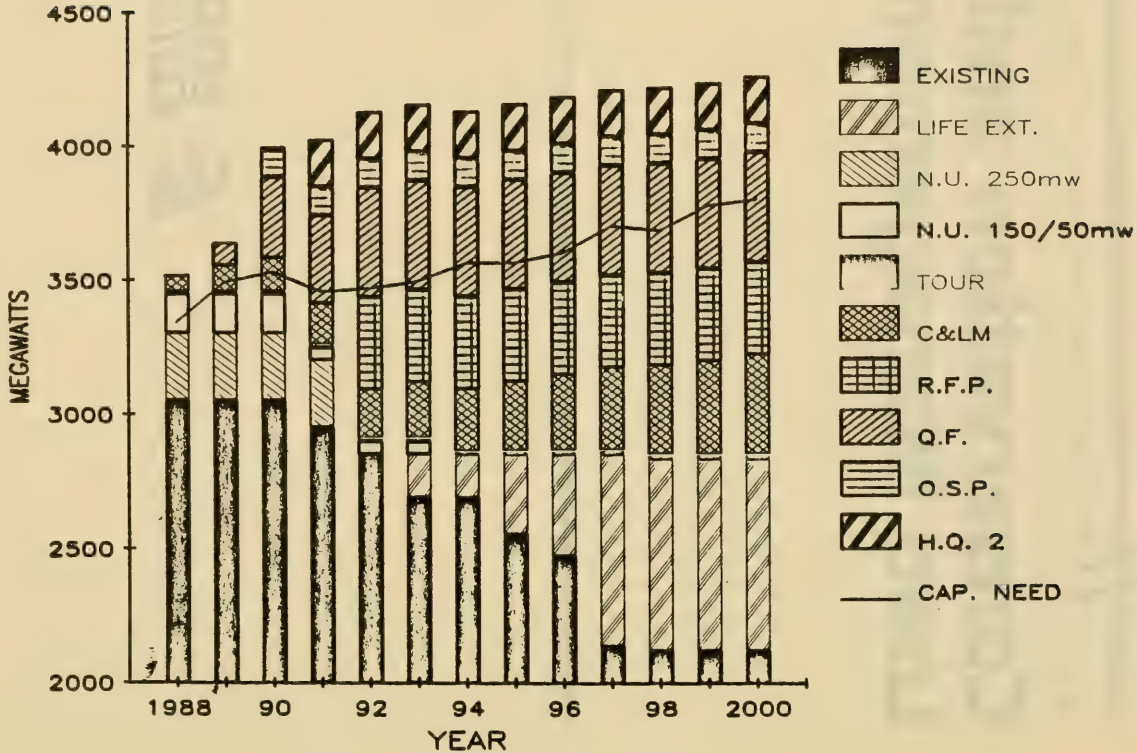
(Appendix 6)

Conservation and Load Management

BOSTON EDISON

EXHIBIT V-1

BOSTON EDISON's
LONG RANGE RESOURCE PLAN



The CHAIRMAN. Our final panel this evening is comprised of the people who make the decisions, Nuclear Regulatory Commission and the Federal Emergency Management Agency. We heard a great many serious concerns, voices, this evening about the way in which the NRC and FEMA are regulating the Pilgrim plant, are planning for emergency preparedness. Here this evening to respond to these questions is Dr. Thomas Murley, director of the NRC's Office of Nuclear Reactor Regulation. Along with Dr. Murley is Mr. William Russell, NRC's regional administrator. Also on the panel are the representatives from FEMA, Mr. Richard Krimm, the assistant associate director of FEMA and Mr. Jack Dolan from FEMA Region Number I. And I'm anxious to hear from you, gentlemen, in response.

First of all, we'll hear from Mr. Krimm

STATEMENTS OF RICHARD KRIMM, ASSISTANT ASSOCIATE DIRECTOR OF FEMA; DR. THOMAS MURLEY, DIRECTOR OF THE NCR'S OFFICE OF NUCLEAR REACTOR REGULATIONS; WILLIAM RUSSELL, NCR'S REGIONAL ADMINISTRATOR, REGION I; AND JACK DOLAND, FEMA REGION I

Mr. KRIMM. Thank you very much.

The CHAIRMAN. They have been sworn in.

Mr. KRIMM. My name is Richard Krimm. I'm the assistant associate director of the Federal Emergency Management Agency responsible for the development and management of FEMA's program related to technological and natural hazards. These programs include radiological emergency planning [REP] around nuclear powerplants, as well as planning for hazardous materials incidents, earthquakes, dam safety and hurricanes. Accompanying me is Mr. Jack Dolan, FEMA Region I, Boston, and Mr. George Watson, from our Office of General Counsel.

The primary concern of FEMA's REP program is the health and safety of the public around nuclear power plants. FEMA works to achieve this goal through an evaluation of plans and preparedness under the FEMA regulation. The evaluation process includes participation by regional assistance committees, [RAC] chaired by FEMA, and includes nine other Federal agencies.

The RAC reviews State and local plans against published criteria, and agency representatives give advice on their particular area of expertise. The published criteria were developed jointly by the FEMA and the NRC with full public participation and contains all the established Federal criteria for developing, reviewing and evaluating radiological emergency, planning and preparedness for commercial nuclear powerplants.

Ultimately, the plans are reviewed and approved at FEMA headquarters. Following approval, FEMA notifies the NRC and the Governor and publishes a notice in the Federal Register. This is done only if a determination is made following appropriate plan exercises that there is reasonable assurance that the public health and safety can be protected in the event of a radiological emergency at the plants.

Let me just briefly discuss Pilgrim. In a series of meetings with the Commonwealth and the local communities in the spring of

1986, FEMA identified problems with the Commonwealth's emergency response plan. Based on issues raised at these meetings and information received subsequently, FEMA decided to conduct a review of the emergency response plan and preparedness for the Pilgrim nuclear power station, and so informed the Commonwealth in a letter to the Massachusetts Civil Defense Agency on September 5, 1986.

On December 22, 1986, the Secretary of Public Safety, Charles Barry, forwarded to FEMA a copy of the report to the Governor on emergency preparedness for an accident at the Pilgrim Power Station. This report stated that the Massachusetts plan and its preparedness are inadequate to protect the health and safety of the public in the event of an accident at the Pilgrim nuclear power station. In the course of its self-initiated review, FEMA treated this report as the authoritative and current position of Commonwealth.

On August 6, 1987, FEMA transmitted to the Commonwealth of Massachusetts and the NRC its report entitled, "Self-Initiated Review and Interim Finding for the Pilgrim Nuclear Power Station." The report was provided to the Commonwealth and NRC pursuant to the regulation and identified six areas of major concern.

These are lack of reception centers for people evacuating to the north; lack of evacuation plans for public and private schools and day-care centers; and lack of identifiable public shelters for the beach population; inadequate planning for the evacuation of the special needs population; inadequate planning for evacuation of the transport dependent population, and overall lack of progress in planning in emergency preparedness.

Based on the Self-Initiated Review and Interim Finding, FEMA concluded that Massachusetts offsite radiological emergency planning and preparedness was inadequate to protect the public health and safety in the event of an accident at Pilgrim. The current status of this when we translated the Self-Initiated Review to Massachusetts, we suggested that they work with us to develop a plan and schedule to correct the inadequacies in their plan. The Commonwealth has not yet developed such a work plan as scheduled.

However, since the issuance of the new interim finding and the publication of FEMA's Self-Initiated Review and Interim Finding on Pilgrim, the Commonwealth of Massachusetts has taken action to address some outstanding issues.

FEMA looks forward to working with the Commonwealth and affected communities in order to achieve our common goal of protecting the public health and safety.

We are prepared to respond to your questions, Senator Kennedy.

[The prepared statement of Mr. Krimm follows:]

STATEMENT BY RICHARD W. KRIMM

ASSISTANT ASSOCIATE DIRECTOR

OFFICE OF NATURAL AND TECHNOLOGICAL HAZARDS PROGRAMS

STATE AND LOCAL PROGRAMS AND SUPPORT DIRECTORATE

FEDERAL EMERGENCY MANAGEMENT AGENCY

BEFORE THE

COMMITTEE ON LABOR AND HUMAN RESOURCES

U.S. SENATE

IN PLYMOUTH, MASSACHUSETTS

JANUARY 7, 1988

MY NAME IS RICHARD W. KRIMM. I AM ASSISTANT ASSOCIATE DIRECTOR OF THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) RESPONSIBLE FOR THE DEVELOPMENT AND MANAGEMENT OF FEMA'S PROGRAMS RELATED TO TECHNOLOGICAL AND NATURAL HAZARDS. THESE PROGRAMS INCLUDE RADIOLOGICAL EMERGENCY PLANNING AROUND NUCLEAR POWER PLANTS, AS WELL AS PLANNING FOR HAZARDOUS MATERIALS INCIDENTS, EARTHQUAKES, DAM SAFETY AND HURRICANES. ALSO, AS OFFICE DIRECTOR, I CHAIR THE FEDERAL RADIOLOGICAL PREPAREDNESS COORDINATING COMMITTEE (FRPCC) WHICH INCLUDES OFFICIALS FROM THE DEPARTMENTS OF ENERGY, COMMERCE, HEALTH AND HUMAN SERVICES, TRANSPORTATION, AGRICULTURE, INTERIOR, DEFENSE, THE ENVIRONMENTAL PROTECTION AGENCY AND THE NUCLEAR REGULATORY COMMISSION. IN ADDITION, I CO-CHAIR WITH THE NUCLEAR REGULATORY COMMISSION (NRC) MONTHLY MEETINGS OF THE FEMA/NRC STEERING COMMITTEE. THESE TWO COMMITTEES, AT THE NATIONAL LEVEL, DEAL WITH POLICY MATTERS RELATED TO OFFSITE PLANNING AND PREPAREDNESS AT COMMERCIAL NUCLEAR POWER PLANTS ACROSS THE COUNTRY.

I AM PLEASED TO APPEAR BEFORE YOU TO REPRESENT THE FEDERAL EMERGENCY MANAGEMENT AGENCY AND TO DISCUSS THE RADIOLOGICAL EMERGENCY PREPAREDNESS (REP) PROGRAM, AS IT RELATES TO OFFSITE EMERGENCY PLANNING IN THE PLUME EXPOSURE EMERGENCY PLANNING ZONE FOR THE PILGRIM NUCLEAR POWER STATION.

ACCOMPANYING ME IS MR. JACK DOLAN, FEMA REGION I, BOSTON AND MR. GEORGE WATSON FROM OUR OFFICE OF GENERAL COUNSEL.

BEFORE DISCUSSING PILGRIM SPECIFICALLY, I WOULD LIKE TO OUTLINE THE CONTEXT OF PROGRAM PROCEDURES AND PHILOSOPHY IN WHICH THE PILGRIM SITUATION HAS UNFOLDED. THE PRIMARY CONCERN OF FEMA'S REP PROGRAM IS THE HEALTH AND SAFETY

OF THE PUBLIC AROUND NUCLEAR POWER PLANTS. FEMA WORKS TO ACHIEVE THIS GOAL THROUGH AN EVALUATION OF PLANS AND PREPAREDNESS UNDER THE FEMA REGULATION 44 CFR 350. THIS FEMA PROCESS, GOVERNED BY THE REGULATION, PRIMARILY INVOLVES A FORMAL SUBMISSION BY THE GOVERNOR, OR HIS/HER DESIGNEE, OF THE STATE AND LOCAL PLANS FOR THE EMERGENCY PLANNING ZONE (EPZ) AROUND A SPECIFIC NUCLEAR POWER PLANT. THE EVALUATION PROCESS INCLUDES PARTICIPATION BY A REGIONAL ASSISTANCE COMMITTEE (RAC), CHAIRED BY FEMA, WHICH INCLUDES, AT THE REGIONAL LEVEL, THE SAME AGENCIES I MENTIONED AS BELONGING TO THE FRPCC.

THE RAC REVIEWS THE STATE AND LOCAL PLAN, AGAINST PUBLISHED CRITERIA (NUREG-0654/FEMA-REP-1, REV. 1), AND AGENCY REPRESENTATIVES GIVE ADVICE ON THEIR PARTICULAR AREAS OF EXPERTISE. THE PUBLISHED CRITERIA WERE DEVELOPED JOINTLY BY FEMA AND NRC WITH FULL PUBLIC PARTICIPATION AND CONTAINS ALL THE ESTABLISHED FEDERAL CRITERIA FOR DEVELOPING, REVIEWING AND EVALUATING RADIOLOGICAL EMERGENCY PLANNING AND PREPAREDNESS FOR A COMMERCIAL NUCLEAR POWER PLANT EMERGENCY. THE PUBLISHED CRITERIA CONTAIN 16 MAJOR PLANNING STANDARDS, WHICH ARE FURTHER BROKEN DOWN INTO 196 EVALUATION CRITERIA ADDRESSING SUCH ELEMENTS AS EMERGENCY COMMUNICATIONS, PUBLIC WARNING, AND PUBLIC EDUCATION AND INFORMATION.

THE APPROPRIATE FEMA REGIONAL OFFICE COORDINATES THE PLANNING REVIEW AND ASSURES THAT AN EXERCISE IS CONDUCTED TO ADEQUATELY TEST THE PLANS. THE REGIONAL OFFICE OR STATE ALSO CONDUCTS A PUBLIC MEETING TO INFORM INTERESTED PARTIES OF THE CONTENT OF THE PLANS AND WHAT WOULD BE EXPECTED OF THE PUBLIC IN THE EVENT OF AN EMERGENCY AT THE PLANT. FEMA, THROUGH THE PUBLIC MEETING FORUM ENSURES THAT THE PUBLIC INPUT IS CONSIDERED AND INCORPORATED INTO THE DESIGN OF THE PLANS, WHERE APPROPRIATE.

In addition, FEMA also provides technical assistance to State and local governments to enhance the overall planning and preparedness effort. As an example, FEMA has frequently provided technical assistance to the Commonwealth in the development of plans pursuant to our regulations. Another example of this is our training program, which includes courses in radiological emergency response planning and accident assessment at the FEMA National Emergency Training Center in Emmitsburg, Maryland, and a course to train Radiological Emergency Response Teams at the Nevada Nuclear Test Site. These courses are primarily for State and local officials.

Ultimately, the plans are reviewed and approved at FEMA Headquarters. Following approval, FEMA notifies the NRC and the Governor and publishes a notice in the Federal Register. This is done only if a determination is made, following appropriate plan exercises, that there is reasonable assurance that the public health and safety can be protected in the event of a radiological emergency at the plant. However, the process does not end with the initial approval. The State and the affected local governments must continue to keep plans updated and they must also participate in periodic exercises with the utility as a condition of continued FEMA approval.

FEMA and NRC have also signed a Memorandum of Understanding (MOU), most recently revised in April, 1985. This MOU calls for FEMA to supply NRC with advice on offsite preparedness issues. Typically, under the MOU, FEMA provides "interim" offsite safety findings that are used in licensing decisions made by the NRC. These "interim" findings are a snapshot in time of the preparedness

POSTURE AT A GIVEN SITE. IT IS IMPORTANT TO NOTE THAT FINDINGS MADE UNDER OUR REGULATION (44 CFR 350) OR INTERIM FINDINGS UNDER THE MOU ARE MADE ON THE SAME BASIS, THAT IS, UNDER THE PUBLISHED CRITERIA.

PILGRIM

IN A SERIES OF MEETINGS WITH THE COMMONWEALTH AND LOCAL COMMUNITIES IN THE SPRING OF 1986, FEMA IDENTIFIED PROBLEMS WITH THE COMMONWEALTH'S EMERGENCY RESPONSE PLANS. BASED ON ISSUES RAISED AT THESE MEETINGS, AND INFORMATION RECEIVED SUBSEQUENTLY, FEMA DECIDED TO CONDUCT A REVIEW OF THE EMERGENCY RESPONSE PLANS AND PREPAREDNESS FOR THE PILGRIM NUCLEAR POWER STATION AND SO INFORMED THE COMMONWEALTH IN A LETTER TO THE MASSACHUSETTS CIVIL DEFENSE AGENCY (MCDA) ON SEPTEMBER 5, 1986.

ON DECEMBER 22, 1986, THE SECRETARY OF PUBLIC SAFETY, CHARLES BARRY, FOWARDED TO FEMA A COPY OF THE "REPORT TO THE GOVERNOR ON EMERGENCY PREPAREDNESS FOR AN ACCIDENT AT THE PILGRIM NUCLEAR POWER STATION" (HEREINAFTER CALLED THE BARRY REPORT). THIS REPORT STATED THAT THE MASSACHUSETTS PLAN AND ITS PREPAREDNESS ARE INADEQUATE TO PROTECT THE HEALTH AND SAFETY OF THE PUBLIC IN THE EVENT OF AN ACCIDENT AT THE PILGRIM NUCLEAR POWER STATION. FEMA WAS SUBSEQUENTLY INFORMED THAT THE GOVERNOR AND THE DIRECTOR OF THE MASSACHUSETTS CIVIL DEFENSE AGENCY HAD ENDORSED THE BARRY REPORT. IN THE COURSE OF ITS SELF-INITIATED REVIEW, FEMA TREATED THIS REPORT AS THE AUTHORITATIVE AND CURRENT POSITION OF THE COMMONWEALTH.

ON AUGUST 6, 1987, FEMA TRANSMITTED TO THE COMMONWEALTH OF MASSACHUSETTS AND THE NRC ITS REPORT ENTITLED "SELF-INITIATED REVIEW AND INTERIM FINDING FOR THE PILGRIM NUCLEAR POWER STATION". THE REPORT WAS PROVIDED TO THE COMMONWEALTH AND NRC PURSUANT TO THE REGULATION AND IDENTIFIED SIX (6) AREAS OF MAJOR CONCERN:

- Lack of a reception center for people evacuating to the north.
- Lack of evacuation plans for public and private schools and daycare centers.
- Lack of identifiable public shelters for the beach population.
- Inadequate planning for the evacuation of the special needs population.
- Inadequate planning for evacuation of the transport dependent population.
- Overall lack of progress in planning and apparent diminution in emergency preparedness.

Based on the Self-Initiated Review and Interim Finding, FEMA concluded that Massachusetts offsite radiological emergency planning and preparedness was inadequate to protect the public health and safety in the event of an accident at Pilgrim.

Shortly thereafter, NRC informed the Boston Edison Company of FEMA's finding. They encouraged the utility to address the underlying issues in cooperation with the Commonwealth and stated that the status of all issues upon which the finding was based would be taken into consideration in decisions about the restart of the plant. NRC's prompt notification to the licensee about the offsite problems at the site is consistent with the FEMA/NRC policy of cooperative effort towards addressing issues of this serious nature.

Current Status

When we transmitted the self-initiated review to Massachusetts we suggested that they work with us to develop a work plan and schedule to correct the inadequacies in their plan. The Commonwealth has not yet developed such a work plan or schedule; however, since the issuance of the new interim finding

AND THE PUBLICATION OF THE FEMA SELF-INITIATED REVIEW AND INTERIM FINDING ON PILGRIM, THE COMMONWEALTH OF MASSACHUSETTS HAS TAKEN ACTIONS TO ADDRESS OUTSTANDING ISSUES:

° ON DECEMBER 17, 1987, IN A LETTER FROM GOVERNOR DUKAKIS TO OUR REGIONAL DIRECTOR, MR. HENRY VICKERS, THE COMMONWEALTH INDICATED THAT PROGRESS IS BEING MADE IN SEVERAL AREAS. FOR EXAMPLE, THEY INDICATED THAT DRAFT REVISIONS TO THE LOCAL PLANS EXIST IN PART FOR EACH OF THE FIVE EPZ COMMUNITIES. IN SOME CASES THE DRAFT REVISIONS WERE INDICATED AS BEING UP TO 85% COMPLETE. THEY FURTHER STATED THAT WHEN OFFICIALS OF ALL OF THE COMMUNITIES AND STAFF OF THE MASSACHUSETTS CIVIL DEFENSE AGENCY/OFFICE OF EMERGENCY PREPAREDNESS INDICATE THAT THE INITIAL DRAFTS ARE COMPLETED, THE DRAFTS WILL BE SUBMITTED TO FEMA FOR INFORMAL TECHNICAL REVIEW.

° THE MASSACHUSETTS BUREAU OF RADIATION PROTECTION, WHICH IS PART OF THE COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH, HAS SUBMITTED TO FEMA A DRAFT OF THEIR INGESTION PATHWAY PLAN WHICH THE RAC IS REVIEWING AT THIS TIME AND PLANS TO COMPLETE BY THE END OF JANUARY AT WHICH TIME THE RAC'S COMMENTS WILL BE FORWARDED TO THE COMMONWEALTH.

FEMA LOOKS FORWARD TO WORKING WITH THE COMMONWEALTH AND AFFECTED COMMUNITIES IN ORDER TO ACHIEVE OUR COMMON GOAL OF PROTECTING THE PUBLIC HEALTH AND SAFETY. WE STAND READY TO PROVIDE TECHNICAL ASSISTANCE TO THE AFFECTED PARTIES IN THE RESOLUTION OF OFFSITE ISSUES ASSOCIATED WITH THIS SITE.

WE ARE PREPARED TO RESPOND TO YOUR QUESTIONS.

The CHAIRMAN. We'll hear from both the representatives of FEMA.

Mr. DOLAN. I don't have a statement Senator.

The CHAIRMAN. I want to say first of all, how much we appreciate your attendance here, Mr. Krimm. I understand that there have been occasions when FEMA has not been so willing to attend meetings. I also want to say that I regret FEMA's decision concerning the participation of Mr. Ed Thomas. It is unfortunate that the agency doesn't feel that this hearing was of sufficient importance to warrant Mr. Thomas' presence.

I've had the opportunity to review the emergency preparedness plan which was in place when FEMA published its interim finding, that the plan offered reasonable assurance that the public could be protected in the event of radiological emergency. I'd like for a moment to present some excerpts from the FEMA's subsequent self-initiated review of that plan.

I quote:

> Existing local plans do not include a list of the resources the town plan used in assisting mobility impaired people during evacuation. FEMA could no longer state with confidence that the beach population can be protected; FEMA can no longer state with confidence that a reasonable assurance exists that the health and safety to transport the dependent population can be protected in the event of an accident.

These are just a few of the serious deficiencies quoted in FEMA's own assessment.

I would like to know, Mr. Krimm, how a plan so obviously deficient could possibly have received interim approval by FEMA?

Mr. KRIMM. In early 1980, when we did give approval I think that, number one, we were new in the game, as was the Commonwealth of Massachusetts. We were really just starting out. We have gotten more staff and we have become more expertise in reviewing plans and making our findings to the NRC.

The CHAIRMAN. Well, it would seem you wouldn't need a lot of experience in developing an evacuation plan if the plan didn't include a list of the resources to be used in assisting mobility impaired people; and it says that you can no longer state with confidence that the beach population can be protected; and you can no longer state with confidence that reasonable assurance exists that the health and safety of the dependent population can be protected; those are pretty basic and fundamental questions, I would think. I mean, you don't have to be terribly new in the game to understand if you can't find ways of evacuating people who are sick or infirm, it would seem to me that that would pretty well jump out at you. I mean, if you can't evacuate the people along the beach population—those things would be pretty self-evident, it would seem to me in terms of raising serious questions about the effectiveness and the efficiency of such a plan.

Mr. KRIMM. I believe that when Mr. Thomas and his staff reviewed the plans that they did assume that some of those things were in order because they had been working with the Commonwealth.

I don't know, Mr. Dolan, if you would like to make any further comments at this time.

Mr. DOLAN. I think at the time when I was there, we became much more sophisticated with what we did. And when we started

with this work in 1982, it was in its infancy, and the other thing that is an important factor is the fact that the population changed dramatically in this area, and that had a profound effect on both the identification of mobility impaired people, and, additionally, the protection of the beach population.

The CHAIRMAN. Does the fact that FEMA missed the important problems the first time around indicate that FEMA needs additional staffing to evaluate emergency preparedness plan?

Mr. KRIMM. Senator Kennedy, fortunately, in the past few years that we have received additional staff from the Congress, and the Congress in fiscal year 1988 appropriation budget, gave us 10 additional positions. Some of these additional positions will be put into the Boston regional office.

The CHAIRMAN. Has there been an increase for Massachusetts, for example?

Mr. KRIMM. Yes, sir. We are increasing the staff.

The CHAIRMAN. You are increasing. Has there been an increase as of today?

Mr. KRIMM. As of today, there are just six people allocated to us.

The CHAIRMAN. How many were there two years ago?

Mr. KRIMM. I'm not sure how many.

Mr. DOLAN. Eight. [Laughter.]

The CHAIRMAN. So there were eight people two years ago. That's some arithmetic. Well——

Mr. KRIMM. It was the case, Senator Kennedy, people sometime leave the agency.

The CHAIRMAN. Well, I know that. But I mean, that's a tough way to try to explain to somebody about problems in evacuation plans that you missed. I happen to be very sympathetic to agencies. I wish they would come out and say, "we can't get the job done unless you give us the personnel, and don't expect us to do it." You know, I like to hear that. We're realistic and understand you have to live with the rest of it, but there is no reason for professional people to take that kind of abuse. If you haven't got the people, then you can't do the job, and then you are doing them an enormous disservice with the responsibility that you have. I think it's unfair to you, and I think it's unfair in terms of trying to deal with an issue that is so vital with respect to people's lives. I don't want to belabor the point, but say we are talking about some matters affecting very, very considerable public health and safety issues, and the American people are certainly entitled to understanding these things.

Let me quote from the FEMA's Self-Initiated Review during the June 30, 1986, public meeting in the town of Plymouth, "the citizen whose children attended private schools inquired about the plans for their evacuation. FEMA promptly researched that and discovered for the first time that private schools were not included in the local plans."

Is that, Mr. Krimm, how FEMA usually assesses a plan—by waiting for the local citizens to ask you whether their children are protected? Why is it that people have to ask? Why is it that you missed something that would probably be as basically fundamental as that? You did miss that. Is the rest of the plan flawed?

Mr. KRIMM. As a rule, Senator Kennedy, we do try to be very thorough, but one of the purposes of having public meetings is to allow the local citizens to bring to our attention things that my have been overlooked, and that is a very important part, trying to get public input into the——

The CHAIRMAN. Well, if you believe that's the case, why doesn't the NRC believe that's the case when they hear from local citizens? Well, I'll have a chance to ask them.

Focusing on the issue of the Memorandum of Understanding between FEMA and the NRC, it is my understanding from the NRC that FEMA serves as the offsite expert on emergency preparedness plans, is that so?

Mr. KRIMM. Yes

The CHAIRMAN. Yet the NRC also says that FEMA's advice is nonbinding; that the NRC can accept or reject FEMA's findings; is that so?

Mr. KRIMM. Yes.

The CHAIRMAN. Does it not appear contradictory to you that the NRC claims FEMA to have the expertise on emergency preparedness, but reserves for itself the right to overrule your determination?

Mr. KRIMM. Well, the NRC has the authority in the licensing in making the determination——

The CHAIRMAN. I understand——

Mr. KRIMM [continuing]. Excuse me. We do act as a consultant to them. We provide the information to the NRC, and, of course, it is their determination what they do with our information.

The CHAIRMAN. Well, I know what the law says, but, I mean, the logic, the common sense; you are the expert, you make recommendations they can ignore. What sense of confidence do you think people ought to have in terms of that process and procedure? I mean, it's——

Mr. KRIMM. Excuse me. I would say in many cases, Senator Kennedy, that the NRC does take our advice and does consider our findings. For example, in 1983, we made a negative finding at the Indian Point power plant in New York State, and the NRC did take action to issue, what is known as a 120-day clock, whereby they advise the utility that they would close the plant.

The CHAIRMAN. Did they close it?

Mr. KRIMM. No. Because the issues were cleared up. Governor Cuomo developed an emergency plan for Rockland County which was a nonparticipating county at that time

The CHAIRMAN. Well, wasn't a result of it that the NRC actually overruled FEMA and allowed the Indian Point to restart?

Mr. KRIMM. No, sir. The emergency plans were developed and the deficiencies were cleared up.

The CHAIRMAN. And FEMA approved the final plans?

Mr. KRIMM. We approved the final plans. The major deficiency at Indian Point at that time was the failure of Rockland County to participate and the State of New York cleared that up. And we also worked with Westchester County on the bus issue, and with some of the other counties with some of their problems

The CHAIRMAN. At the present time, the federal regulations require that an area encompassing a 10-mile radius of a nuclear

power plant have an evacuation plan. Did you know Cape Cod lies just outside the 10-mile radius. It is my understanding that in the event of a full-scale evacuation Sagamore Bridge would be closed to off Cape traffic, and all residents seeking to leave the Cape would be rerouted over Bourne Bridge.

Now, I don't know if you ever had the pleasure [laughter] of trying to drive through the Cape at the end of a sunny, lovely summer weekend, but I can assure you, as a resident, that the experience is not a pleasant one. It is not uncommon to experience hours of traffic delays when both bridges are open for use, and I cannot imagine the nightmare that would ensue if Cape Cod residents were asked to use only one of the bridges for emergency evacuation.

I would ask you, do you really feel that the residents are adequately protected? Let me remind you that in the case of the Chernobyl accident, significantly more than a 10-mile radius was evacuated. In the case of Three Mile Island accident, over 100,000 people left the area; in spite of the instructions that told them to stay.

Mr. KRIMM. I'm very sorry that I'm not familiar with that particular area. I would like to ask Mr. Dolan to respond to that.

Mr. DOLAN. Senator, in 1984, at the request of the NRC and as a result of a petition, we did an extensive study of the traffic management in the area of—from the plant to the other side of the bridge on the Cape Cod Canal. And the state participated in depth in that study.

Our experts told us that the Cape could be evacuated using the procedures set forth by the Massachusetts State Police and the Massachusetts Department of Public Works. And currently, the Commonwealth of Massachusetts has told us that they are again taking a look at the situation with regard to that and they are contemplating the expansion of the emergency planning zones of the Pilgrim power plant to include the towns of Bourne, Wareham, and the third escapes me, the towns in that area, and that's where it stands right now.

The CHAIRMAN. Have you been down there recently?

Mr. DOLAN. Oh, yes, sir. All my life.

The CHAIRMAN. Well, you can take some judicial notice, as they say, of what those weekends are like and what just ordinary traffic is like.

Mr. DOLAN. Well, Senator, I believe it can be evacuated as long as it can be managed properly. [Laughter.]

The CHAIRMAN. I don't know what's not managed properly on just ordinary weekends, just ordinary traffic; and this is one of the growth areas of the country, not only of our state, but of the country. And even if you left down that whole railroad bridge, and you had people scampering across there. [Laughter.]

It really defies the common understanding.

As I understand it, Mr. Krimm, you are from the Washington headquarters?

Mr. KRIMM. Yes, sir.

The CHAIRMAN. Do you have any great knowledge of these evacuation plans?

Mr. KRIMM. Not specifically the area that you mention. I am familiar with certain evacuation plans throughout the country.

The CHAIRMAN. The area that I was just talking about, Cape Cod; what about this area here?

Mr. KRIMM. No, sir. I'm not.

The CHAIRMAN. Well, it would seem to me that someone of your responsibility would have some information about one of the key elements in terms of an evacuation plan. You've got major responsibilities, as I understand, in making some judgments on this. And it kind of appalls me that—I mean, I don't expect you to have the full information, perhaps the detailed information that the people in the locale have, but I would certainly hope that, given the kinds of problems that have affected this particular plant and the significance of the evacuation issue that's been very much a part of the concern of everyone in this state, and I would think people around the country, that you would have given it the kind of attention that apparently you have given to some of the others.

In view of the fact that FEMA is unable to supercede the NRC's decision on emergency preparedness, would FEMA support a congressional requirement to give FEMA the authority to override the NRC on issues of emergency preparedness?

Mr. KRIMM. I listened very carefully when the Lt. Governor brought that up. If I may submit something for the record, I would like to think about it a little before. I would like to try to develop the cons and pros for it, I would submit something for the record.

The CHAIRMAN. When you do, we'll make that available to the citizens up here. But what I'm really interested in is FEMA's support for its having the final decision over whether a plant stays open—if the public cannot be reasonably assured of evacuation protection; that would be the question I'm interested in your response to.

[Response of Mr. Krimm to Senator Kennedy's question follows:]

RESPONSE TO PREVIOUS QUESTION

Answer. In response to your questions if the FEMA would support legislative action to give the FEMA the authority to override the Nuclear Regulatory Commission (NRC) on issues of offsite emergency preparedness, the FEMA does not recommend that it be given such authority, at this time, for the following reasons:

1. On the whole, the NRC has used and reflected FEMA's offsite findings and determinations in all of its licensing decisions. This woudl indicate that the present arrangements are satisfactory.

2. A change could bifurcate the current integrated licensing process resulting in two separate licensing processes, onsite and offsite.

3. It is estimated that the FEMA would require an additional staff of 50 to 75 FTE and an increased annual budget of $7 to $8 million dollars. The additional resources are required for judicial reviews, hearings, public meetings and administrative requirements needed for a regulatory activity.

The CHAIRMAN. One final question, you mentioned in your testimony the report by Secretary Barry on the emergency preparedness plan and the fact that the State has not yet submitted to you all of its revision. I wonder if you can tell us how long it would take FEMA to evaluate the plan after it's been submitted and how long it would take FEMA to ultimately advise the NRC of the acceptability of a plan?

Mr. KRIMM. Once the plan is submitted, of course, it will be reviewed by the Regional Assistance Committee, and depending on the time and the problems, they should be able do it in about 30 days.

Mr. DOLAN. Three months.

Mr. KRIMM. Ninety days.

The CHAIRMAN. Well, what assurance can you give us that Pilgrim won't start before that time?

Mr. KRIMM. That is not my decision. I can't give you any assurances.

The CHAIRMAN. Whose decision is it?

Mr. KRIMM. That's the Nuclear Regulatory Commission's decision.

The CHAIRMAN. Can you give us any assurance about that?

Mr. MURLEY. I'll speak to that in my testimony, if I could.

The CHAIRMAN. We'll hear from Dr. Murley, who is the Director of the Office of Nuclear Reactor Regulations at the Nuclear Regulatory Commission.

Mr. MURLEY. Thank you, Mr. Chairman. I'll summarize my remarks, which I provided to the committee in more detail.

First, I should say that we're not prepared at this time to recommended restart of the Pilgrim plant nor do we have a schedule for the restart for the plant.

The CHAIRMAN. Let me ask just before you move on. You say, "we are not ready to recommend restart nor do we have a plan." Can you indicate to us what would be the factors that you would look for to determine whether you will have a plan or whether you will permit restart? What are the events? What are the things that have to happen?

Mr. MURLEY. What I——

The CHAIRMAN. If you repeat them in your statement, I would like to permit you the full opportunity to do that but, as you move through the testimony, we're reaching the end of the hearing, so I'm going to maintain a little more flexibility. If you have it later on in your statement, just mention that to me, but if you don't, I would appreciate if you would be responsive.

Mr. MURLEY. The major factors that we're going to look for are the deficiencies in the plant equipment that we found through our inspection; the deficiencies in the management of the plant and the deficiencies in the emergency preparedness.

The CHAIRMAN. But again, can you indicate how long it will take to look at plant management and evacuation? Do you have any general ballpark figures? Mr. Doland indicated they thought around 90 days. In each one, how long would that take.

Mr. MURLEY. After the Boston Edison Co. submits to us their indication that they believe they are ready to restart, we think it will take perhaps a month to 2 months, probably closer to 2 months by the time we send our own team of inspectors in, to review and come to our own conclusion.

The CHAIRMAN. When does Boston Edison indicate to you they will submit their recommendations?

Mr. MURLEY. They have indicated, I think, informally to us, it would probably be in late January or February.

The CHAIRMAN. On the question of the plant, you expect in late January or February, to receive from Boston Edison the final plant designs in terms of safety, and then it will take you approximately 30 days for you to send your people up there and conduct their review, or does it take 30 days to get your people to get together?

Mr. MURLEY. No, we would have our teams ready. It would take probably 2 to 3 weeks at the plant. We would then have to collect our information and pull it together, make our conclusions. That would take another month, so altogether, perhaps 2 months.

The CHAIRMAN. So we are generally thinking sometime in early March that you'll at least be able to make some judgment. I suppose you may have to go back and get additional information. The fastest track would be in March. What about with regards to management?

Mr. MURLEY. With management, we're making continuous assessments. What we will do, of course, is watch their performance while they are getting the plant ready and also during the times when they will be conducting what we call "hot functional tests."

The CHAIRMAN. What is a "hot functional test"? When do they start?

Mr. MURLEY. Well, they'll being doing some testing, not nuclear testing, and we'll be watching and observing how the plant is being operated.

The CHAIRMAN. What sort of testing do they do now?

Mr. MURLEY. For example, I was in the plant all morning, and they have a steam supply from a fossil-fired boiler to generate steam to run steam turbines for the safety pumps. They will test them and they will test the systems to see if there is leak. We watch them carefully because it is a nuclear plant and there is radiation in the plant. Even though this is a non nuclear test, we watch them.

The CHAIRMAN. Have you reached any preliminary conclusions that you want to share with us?

Mr. MURLEY. No firm conclusions. I think we can say that they made some significant management changes in the company that we believe are improvements. Ralph Byrd, for example, was brought in after years of experience in the nuclear navy, who was an admiral. He, in turn, has brought in a number of capable people. It remains to be seen whether they can gel as a team that can really manage——

The CHAIRMAN. How long does it take with respect to the evacuation plan?

Mr. MURLEY. We are reviewing the drafts as they are prepared by the state and local authorities, and we expect that the state will send those to FEMA. At that time, we'll have to come to a judgment as to the status of those plans.

I say it in a little more structured way in the testimony, if I could go through it, I would like to do that.

The CHAIRMAN. All right. Go ahead.

Mr. MURLEY. With regard to the current status of the major NRC activities concerning Pilgrim, the plant is shut down; the NRC has met frequently with the Boston Edison Company, members of the public and with the Commonwealth, as well as local officials, to discuss the issue regarding Pilgrim.

Boston Edison has developed a restart plan that describes their programs and plans, but they have not reached a position where they would request NRC to consider a restart decision. In addition, as part of its safety enhancement program, Boston Edison has proposed a number of modifications intended to improve plant per-

formance in the event of an accident at Pilgrim. These modifications are in consonance with the NRC's goals of enhancing containment performance under severe accident conditions.

We will conduct several public meetings to insure opportunity for public participation and input to the assessment panel regarding Boston Edison's restart plan. These meetings will be formal, transcribed sessions in which the public's testimony will be heard by NRC senior staff.

After the NRC staff has completed the restarts readiness assessment, there will be a public meeting at NRC headquarters at which the staff will inform the NRC commissioners on our findings and recommendations, so that the Commission itself can make the final restart decision.

The CHAIRMAN. Now, who is going to be able to appear at that public meeting?

Mr. MURLEY. Any interested citizen.

The CHAIRMAN. This is in Washington; is that correct?

Mr. MURLEY. The meetings that we'll have will be here in the Plymouth area to get concerned citizens' input on the plan itself and our approach to the plan. The Commission meeting, if that's what——

The CHAIRMAN. Who will be at the meeting?

Mr. MURLEY. It will be the senior staff from our headquarter and from our regional office.

The CHAIRMAN. None of the Commissioners would come up to that meeting?

Mr. MURLEY. Probably not. It would not be an adjudicatory hearing. It would be a more informal meeting. It will last as long as people will be interested in talking.

The CHAIRMAN. You and I know that, quite frankly, there is a difference if you have the staff hold the hearing or whether you have the principals. With no disrespect, because I have an excellent staff and am proud of them, as you know, and I know, there is a quantum difference on those kinds of situations. People are busy, and all the rest, but it is an unique set of circumstances.

You've got two situations, Pilgrim and Seabrook. You may have, I don't know, half a dozen maybe—I don't know what the others would be. I know one or two that are of such significance and importance.

I find it difficult to understand what would be more important than those fellows getting out in one of those Gulfstream planes that the government has and spend a nice day up in the Plymouth area and fly back so they could be back with their families at nighttime. I really don't know what in the world is more important than spending that particular day.

[Applause]

The CHAIRMAN. We'll request it nicely of them. Hopefully, they'll be responsive, but whatever decision is going to be made, how important it is that people have an opportunity to be heard on these issues; and I find having sat through the hearings tonight, that these are well-thought out, well-considered, very well-studied testimonies. I mean all of us ought to be able to hear whatever people we represent have on their minds in any event, but I think you would agree that these are very impressive pieces of testimony that

people spent a lot of time on. Well, I urge you to give that consideration. I will, and I'm sure I will be joined by my colleagues, but let's go on with your testimony.

Mr. Murley. Yes, Senator. I'll move on now to emergency preparedness.

The Chairman. What page are you on?

Mr. Murley. I'm sorry. I have a version that—when you asked that we limit it to 3 minutes.

The Chairman. You can take a little longer time, if you'd like to. I have the testimony which you submitted earlier where you said on page 1, "that report brought into focus a number of problem areas at Pilgrim, such as a shortage of licensed operators, a large maintenance backlog, with a number of management vacancies in the maintenance area, radiological protection program weaknesses; emergency preparedness program weaknesses, and instances of poor procedural adherence and administrative practices at the plant." Have all of these been corrected?

Mr. Murley. They have not yet been corrected. No, sir.

The Chairman. On the top of page 2, and then I'll let you continue, you report that "there are five areas that exhibited recurrent program weaknesses. These are radiological controls, surveillance of safety-related equipment, fire protection, physical security and safeguards, and assurance of quality."

Now, have those been corrected yet?

Mr. Murley. They have not been corrected. We have seen signs of improvement, particularly in the radiological control area and fire protection and assurance of quality, but we haven't—they haven't been corrected.

The Chairman. Can you give us a rough idea? Ten is the standard in order to perfect. They ought to get your C grade. I mean that's sort of minimum grade. Where are you on the radiological controls? How close are they to being at minimum standards?

Mr. Murley. I think I would say now that they do meet our minimum standards. It's difficult to give them a numerical grade, but I can give you an idea of the action that we take when we think they fall below standards in one of these areas. This was several years ago in the radiological control area.

We felt if they fell below these standards, there were practices at the plant that we thought were unacceptable, and we took an enforcement action by issuing them an order. An order is a formal action that modifies a license, and we directed them to get an outside consultant to come in and help them formulate improvements to the program, and we then made them implement those improvements. It took a very long time for them to do it, and just recently Mr. Russell closed out the order on the basis that we have seen improvements.

The Chairman. Well, when you found these deficiencies on radiological controls—did you close down the plant?

Mr. Murley. No, we didn't.

The Chairman. Why not?

Mr. Murley. There are many areas that go into our judgment as to the overall operation of the plant. Radiological control is one of them. I said fire protection is another. If there's an area we judge to be serious enough, we'll not hesitate to shut it down. We have

nine plants shut down in the United States today because we don't think they are safe enough to operate; Pilgrim being one of them.

Regarding radiological control, what we did, we issued an enforcement order on their license.

The CHAIRMAN. Well, you know, I would think that after the NRC identifies this plant as probably the least safe plant in the country and you don't close it down, people are going to ask about it, don't you think? What does it take? You've got nine down. You say that this is one of the least safe plants in the country. Boston Edison closes it down, but you people don't. What kind of assurances can people have in terms——

Mr. MURLEY. Although we didn't issue a formal enforcement order, we did, in fact, tell them to shut down the plant. This was in April of 1986.

The CHAIRMAN. That's right. Well, in other circumstances, you close them or do you ask the company to close them down?

Mr. MURLEY. We ask the company to close them down. In the case of the Peach Bottom plant, we ordered them to immediately shut down. So in that case we issued an immediately effective order.

The CHAIRMAN. All right. Let's just continue with your testimony.

Mr. MURLEY. I'm now talking about——

The CHAIRMAN. Let's go down—we've had a long evening, but I'm not in any hurry right now. If we could go down to the bottom of 2. You say, "Let me summarize the current status of major Boston Edison and NRC activities regarding the Pilgrim facility." Let's pick up there. Have you got your copy?

Mr. MURLEY. Yes, sir. The facility remained shut down. The NRC has met frequently with Boston Edison, members of the public and with the Commonwealth as well as with local officials.

The CHAIRMAN. Who of the public have you met with? Do you know?

Mr. MURLEY. Yes. I have met several times with the Selectmen. I have spent an evening in this very auditorium with the Selectmen and with several other people, probably until past midnight, answering questions. My staff and Mr. Russell's staff have met in Duxbury with similar groups. I would guess there have been probably, all in all, half a dozen or more meetings with people in this area.

The CHAIRMAN. Continue.

Mr. MURLEY. Boston Edison has developed a restart plan that describes the program plans, actions considered necessary by the company to restart and safely operate the company. Although Boston Edison has not reached a position where it could request of NRC to consider a restart decision, the utility has completed a number of plant improvements.

The reactor was refueled in October and several major system tests on the reactor cooling system and containment structure have been completed. As part of its safety enhancement program, Boston Edison has proposed a number of modification intended to improve plant performance in the event of an accident at Pilgrim.

The NRC staff reviewed these modifications in August of 1987, and concluded that many of the modifications were appropriate for implementation.

The CHAIRMAN. Does that suggest anything to you? It says Boston Edison proposed a number of modifications to improve plant performance in the event of an accident at Pilgrim. Does that suggest anything to you? Did we draw any conclusions about the considerations as to the safety?

Mr. MURLEY. Yes. We have underway, Senator, a generic study. It is a research study on how we can make these containments even safer. As you know, the issue was raised earlier this evening about the safety of the BWR Mark I containment of the type that Pilgrim has. There are, I believe, 24 such reactors.

NRC believes that they are being safely operated today, but we have research programs to see if we can make them safer. Boston Edison knows the kinds of things that are being considered. They, presumably on their own, assumed that the NRC is coming out with new requirements. We haven't done that, but we are scheduled to go to the Commission this summer and make our recommendations.

The CHAIRMAN. Well, then you wouldn't bring this on-line before then, would you, if you were going to make specific recommendations this summer regarding safety. It wouldn't make any sense, would it, to try to do this prior to that time?

Mr. MURLEY. There are really two answers, Senator. One is that many of the types of things that we're looking at generically, are the very things that Boston Edison has done on their own to improve the plant; and second, if the Commission decides to do even more, we would make at that time, no matter when that is, we would make Boston Edison backfit any additional requirements.

The CHAIRMAN. Can you be just more specific? Does that include the torus vent improvement?

Mr. MURLEY. In our review of that proposed modification, we asked them a number of questions; in particular when they would use it and when they wouldn't. They still owe us a reply on that.

The CHAIRMAN. You are familiar with the technology?

Mr. MURLEY. Yes.

The CHAIRMAN. I mean, do you think that that is a large additional safety factor or is not?

Mr. MURLEY. It does if it is used correctly.

The CHAIRMAN. Let's assume that they use it correctly. I mean, if they are not going to use it correctly, then nothing makes any sense at all. [Laughter.]

Mr. MURLEY. Sir, I wish things were always that clear. Our questions will elicit that very information; namely, have they studied all the cases where it could help and where it could hurt to operate the torus vent.

The CHAIRMAN. What was your impression?

Mr. MURLEY. The containment is a very important structure in the plant. Chernobyl did not have such a containment. The containment that was designed has been required by the NRC on these reactors to contain any radioactivity and fission products.

One does not lightly change the design to deliberately open the containment unless one really knows what is right, and under the

right circumstances. And that's why we're being very cautious on this.

The CHAIRMAN. Does your report reach any conclusion about whether it will be successful or fail?

Mr. MURLEY. There is a report from some of our laboratory experts. They have been looking at the behavior of these Mark I containments under very severe accidents, very unlikely core meltdown accidents. I have not read the report myself, but the indications I have is they concluded that under these very severe conditions, the containment could fail when molten fuel contacts the steel liner parts.

[The report referred to above follows:]

REVIEW OF THE STATUS OF THE MARK I BWR LINER MELT-THROUGH ISSUE

by

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1. INTRODUCTION

The interaction of core debris with the Mark I drywell pressure boundary has recently been the object of intense scrutiny as a result of the NRC's reassessment of risk under severe core damage accident conditions [1]. Traditional containment failure analyses have assumed that the Mark I drywell would fail by overpressurization at the drywell knuckle-weld position at a pressure of 132 psia [2]. This pressure may be generated as a result of non-condensable gases accumulated in the drywell atmosphere due to a molten core-concrete interaction (MCCI) and some analyses have indicated that this failure mode could be delayed for as long as several hours after pressure vessel failure [3]. Other study group activities have examined the leak-before-failure mode of containment failure due to high drywell atmosphere temperature as an alternative to gross overpressure failure [4]. However, the Containment Performance Working Group (CPWG) results similarly indicate a delay of one to several hours between vessel failure and the onset of leakage. The principle driver for both cases, high drywell pressure and temperature, would be a MCCI on the drywell floor. During the activities of the Containment Loads Working Group (CLWG), a third mechanism for failure of the drywell pressure boundary was proposed...melt-through of the steel shell by direct contact with core debris. A series of calculations were performed to assess the liner response over a range of parametric variations employed for the overpressure calculations. The series of analyses were consistent in so far as they employed self-consistent initial and boundary conditions, and coupled the results of MCCI analyses with the CORCON code [5] into hand calculations. The results [3,6] indicated that containment failure by liner melt-through was possible under a wide range of parametric conditions within minutes of debris-liner contact. Reference 6 is attached as Appendix A. The conclusion was developed that, for a Mark I BWR, liner failure, given that core debris is expelled from the reactor pressure vessel, is a highly probable mechanism of early containment failure. The liner failure issue was addressed by the containment loads review panel for the NUREG-1150 analyses. An average of the eight SARRP analysts' estimates of the probability of liner failure upon contact with core debris was approximately 75%. When factored into the NUREG-1150 analyses for the Mark I BWR cases, liner melt-through was singularly responsible for increasing the probability of early containment failure from the 5-10% range to the 80-90% range. It is clear that the effectiveness of any accident management strategy developed to mitigate fission product release and off-site consequences will depend upon recognition of this containment vulnerability and integration of liner failure into the strategy.

2. MARK I LINER RESPONSE: NUREG-1079 ANALYSIS

During the analytical exercises of the CLWG with respect to the Mark I BWR, parametric calculations as opposed to best-estimate calculations were performed to investigate the impact of then-poorly understood variables upon the containment response to a MCCI in the drywell. One such parametric variation was the radial spreading of debris on the drywell floor, which was intended to examine the effect of surface area. The radius of spreading was varied from 3 to 5 meters; the 3 meter case represented holding the debris inside the reactor pedestal, while the 5 meter case represented spreading the debris evenly over the in-pedestal floor and 1/2 the ex-pedestal floor area. In order to cause such spreading, it was recognized that the debris would not only have to be molten but would, by definition, have to flow up against the steel containment liner which constitutes the drywell pressure boundary in order to be deflected to spread evenly across half the ex-pedestal floor area. This contact between core debris and the steel liner is subject to vanishingly small uncertainty. The typical drywell floor area is 132 m^2; allowing for floor mounted equipment and blockages, floor coverage of 112 m^2 was chosen, equivalent to a circular radius of 6 meters, for the series of parametric debris-liner melt-through calculations. It should be mentioned that this analysis, by retaining 7 m^3 of debris in the in-pedestal sumps (collapsed debris volume = sump volume) and evenly spreading the rest of the debris over all available floor area results in the minimum possible debris depth on the drywell floor and up against the steel shell. The variables that were chosen for the parametric analyses were concrete type (basalt or limestone), initial corium temperature (1775, 1900, 2550 K), and percent of core debris in drywell (60 or 80%).

It was considered vital that the analyses performed for the liner melt-through assessment be dependent on reasonable and technically defensible assumptions, and that the analyses be consistent and compatible with contemporary severe accident analyses. This, unfortunately, has not been the case with other analyses and this will be delineated in subsequent sections. The explicit assumptions concerning concrete type, corium temperature, composition, and inventory, as well as other initial and boundary conditions and containment conditions required to initialize the CORCON code were chosen to be compatible with the same conditions for the CLWG calculations. These conditions were the subject of extensive review by the CLWG participants and were all assessed as reasonable.

In the formulation of the problem, several implicit assumptions were invoked, among these were the following:

- melt spreadability
- liner back-side thermal boundary condition
- effect of overlying water.

These will be briefly discussed.

The first concern was whether the fluid dynamics of the melt exiting the pedestal needed to be modeled or if the spreading would be so quick that it could be assumed to arrive at the liner almost immediately. The physical properties of the corium, especially the viscosity of the molten metal and oxide phases, were found to be conducive to rapid flow of debris out of the pedestal. This, coupled to the absence of floor-mounted obstacles, was taken as sufficient justification for neglecting the dynamics of melt spreading in favor of the assumption of immediate contact. In assuming immediate contact, the debris was similarly spread over all available floor space, preventing local pile-up and neglecting transient surge effects which might otherwise present a more serious local threat to the liner.

The thermal boundary condition on the back-side of the liner facing the concrete shield wall was the second concern. The 2-inch gap between the shield wall and the liner was found to be full of fibreglass insulation. Furthermore, results of a structural analysis of the Peach Bottom plant indicated that, in spite of radial outward expansion of the steel liner toward the concrete shield wall, this gap would remain open for most of the time of the analysis and, in fact, at or near the point-of-imbedment with the drywell floor, the gap would always remain open [7]. Assuming grey body radiation across an air gap to the concrete, it was found that only 7% of the decay heat could initially be transferred from the steel shell at 1750K to concrete at 373K. Furthermore, the concrete would rapidly heat up, shutting off the temperature difference for heat transfer and rapidly approaching a nearly adiabatic condition. Coupled with the realization that the gap is full of fibreglass insulation which would further impede heat transfer, it was decided to invoke an adiabatic boundary condition. In this way, anomolous numerical effects due to nodalization problems or contact heat transfer and temperature effects which could erroneously bias the results could be avoided.

The third major problem to be considered was the absence or presence of an overlying water pool and its ability to transfer heat from the debris. Much credit has been given to the ability of water to mitigate the effects of severe core damage accidents. Most of this credit is based upon the assumption that an overlying water pool will boil at the critical heat flux and "quench" the debris into cold, coolable rocks [8]. Unfortunately, this assumption is not supported by the prevailing and well-documented data base which indicates that boiling of water over molten core debris would be a film boiling process [9,10]. Since the accident analysis code CORCON did not have a coolant boiling model at the time of these analyses, it was decided to evaluate the effect of water in film boiling vs. convection and radiation heat transfer. Assuming that a means of continuously injecting water into the drywell exists, a film boiling heat flux of approximately 5×10^4 W/m^2 is reasonable (this corresponds to a mass flux of water of 325 lbm/min). CORCON, in the absence of water, would calculate natural convection and radiation heat fluxes from this debris of approximately 2.0×10^4 W/m^2 and 2.9×10^4 W/m^2, respectively; this would be a total heat flux by radiation and convection of 4.9×10^4 W/m^2, not much different from the boiling flux assumed. Although

the magnitude of these numbers could be easily challenged, the agreement is supported by the widely recognized fact that film boiling is an inefficient heat transfer mechanism and supports the substitution of water in film boiling by natural convection and radiative heat transfer. In the assessment of the effect of water boiling over core debris, the possibility of a surface crust on the core debris was neglected. Such crusts have been observed in the Sandia SWISS tests [10], and were found to limit the heat transfer to overlying water pools by imposing a conduction heat transfer resistance between the melt and the water. In none of the tests done to date was it found that water pools would benignly quench simulated core debris. For a more detailed discussion of the calculations and assumptions, the reader is directed to Reference 6 which is attached as Appendix A.

The analyses presented in Appendix A [3,6] represent a consistent treatment of initial and boundary conditions in the drywell, coupled to a mechanistic containment analysis and a mechanistic MCCI analysis through hand calculations. To date, it is the only known analysis to be driven by and consistent with a mechanistic MCCI analysis. Arbitrary assumptions have been avoided wherever possible and all assumptions made have been carefully documented. The results of the liner melt-through analyses, over a reasonable range of parametric variations indicate that, given a core-on-the-floor scenario, it is nearly impossible to conceive of conditions that will not fail the drywell pressure boundary. Reasonable and mechanistic analyses demonstrate that complete local ablation of the drywell shell may occur as soon as several minutes after contact with debris. These analyses neglect such transient effects as initial hydrodynamic surge across the floor and up the liner, radiation from debris to the liner, uneven pile-up of debris along the liner, energetic melt-water interactions which might splash large amounts of melt onto the liner, and structural deformation of the liner due to reduced strength at elevated temperature when in contact with debris. Given that only 9% of the total core debris is required to fill the drywell sumps (boilup to 40% void fraction), and that debris will flow at depths of 4 cm or less, the drywell shell is vulnerable to even the most optimistic assumptions of in-vessel meltdown and transient melt ejection from the failed reactor vessel. The only question that remains is "when will the steel drywell wall fail."

3. MARK I LINER RESPONSE: A CRITICAL REVIEW OF THE IDCOR MODEL

It is the stated objective of the IDCOR-IPE program and the NRC Severe Accident Policy Statement to ascertain if there are any potential risk outliers with respect to core-melt frequency or unusual containment vulnerabilities. One such containment vulnerability has been identified for the Mark I BWR containment steel liner. Primarily on the basis of Reference 3, the failure of the Mark I liner when contacted by core debris following vessel failure was included by the SARRP program in the NUREG-1150 source term analyses [1]. An average of the eight SARRP analysts' estimates of liner failure probability upon contact with core debris, when factored into the analyses in Reference 1, resulted in the probability of early containment failure for Mark I BWRs in the 80-90% range.

The IDCOR analysis in the draft report "Approximate Source Term Methodology for Boiling Water Reactors" [8] recognized this potential containment failure mode and reexamined the liner vulnerability or survivability in a separate analysis. In what was characterized to be a "conservative" analysis, the report indicated that the steel containment liner would not fail under any of the postulated conditions. This conclusion is in disagreement with the analyses presented in Reference 3, as well as with the containment event tree issues in SARRP for the Mark I containment analyses. As such, the models and assumptions inherent in the IDCOR analyses will be assessed. The section of Reference 8 that includes the IDCOR liner analyses is attached as Appendix B.

The IDCOR analysis of the behavior of the Mark I containment shell was based upon numerous assumptions and judgements. It is on the basis of these assumptions and judgements that the initial and boundary conditions, physical properties, and phenomenological models were developed. Those assumptions and judgments that could be identified from the text in Reference 8 are discussed below. The IDCOR model assumes that:

(a) The core debris that escapes the pedestal region of the drywell is assumed to be in a thin layer 6-12 cm deep and to be, by definition, solidified [11]. This debris, for the purpose of the analysis in Reference 8, is assumed to consist only of uranium oxide fuel. There is no metal phase present.

(b) Heat transfer within the core debris is assumed to be by conduction only. There is no provision for internal convective processes due to bubbling of concrete decomposition gases.

(c) Heat generation within the core debris is by decay power heating. There are no provisions for the chemical energy source resulting from metal-gas phase reactions between concrete decomposition gases and metallic core debris.

(d) A pool of water overlying the core debris is assumed to boil at the critical heat flux. The film boiling regime is not modeled, and the extensive data base for melt-water interactions is neglected.

(e) The steel liner is modeled to transfer heat from its outer surface by thermal radiation to the surrounding concrete shield wall as well as by convection to the gas in the gap. Both the concrete shield wall and the gas in the gap appear to be infinite heat sinks at a constant low temperature. All emissivities are apparently equal to 1.

(f) The area of the steel liner that is in contact with the overlying water pool is assumed to transfer heat to the water at a rate specified by an arbitrary heat transfer coefficient, h_w. It is assumed to represent nucleate boiling.

(g) The core debris, consisting of UO_2, is assumed to be at a temperature of only 1800 C and less than 12 cm deep. An unspecified "protective layer on the inner steel shell surface" is postulated.

(h) The core debris transfers heat to underlying concrete by conduction. However, the basemat concrete is not allowed to outgas (i.e., dehydrate and decarboxylate) or to ablate. This prevents concrete decomposition gases from entering the debris from below and rules out convective heat transfer and exothermic chemical reactions from occurring in the melt. Once again, the concrete is a passive heat sink.

There may be other fundamental assumptions inherent in the model for liner response when contacted by core debris. However, assumptions (a) - (h) were those that could be readily identified from Reference 8. Nevertheless, these eight categories of assumptions appear to form the basis for the IDCOR approach to the problem; each will be addressed in the following discussion and compared to representative BNL positions or assumptions.

IDCOR assumption (a) assumes that the debris is solidified, and consists of UO_2 fuel only. Since the debris is assumed to be pure UO_2, its thermal conductivity is only 3 W/mK. However, IDCOR's own core-concrete interaction model, DECOMP, is inconsistent with these conditions. DECOMP assumes that the ex-vessel debris is a homogeneous mixture of oxide and metallic core debris phases, not just oxide fuel. This results in a debris pool with a lower melting temperature that can be molten, a more fluid pool of debris, and a higher debris thermal conductivity, in the range of 10-20 W/mK. BNL analyses rely upon the CORCON code. These analyses allow the debris to be molten or solid, depending upon the calculated conditions, not only assumption. The molten oxide and metallic phases solidify in a mechanistic framework in a manner consistent with prevailing thermal hydraulic conditions in the melt and the boundary conditions experienced by the melt. These analyses show that the liner may be contacted by a deeper pool of core debris (> 25 cm) than assumed by Reference 8. Also, this pool can be molten and have a considerable quantity of molten metal phase present, with a thermal conductivity as great as 47 W/mK or more.

IDCOR assumption (b) assumes categorically that the UO_2 core debris is a solidified mass. This precludes internal convective processes from transferring heat to boundaries, especially to the basemat concrete and the steel liner. In deeper pools, this has been shown not to be the case, and the NRC, FRG, and EPRI presently have reactor materials experimental programs in progress to examine the molten stage of debris-concrete interactions. In all the tests to date, the molten attack on concrete was easily sustained.

IDCOR assumption (c) allows for internal heat generation in the solidified fuel by decay heating only. However, reactor materials experiments and code analyses have shown that, especially for BWR cases which may have a large inventory of unoxidized Zr in the melt, the internal heat source due to metal-gas phase chemical reactions will in general exceed the decay heat generation by a large margin, in most cases representing the driving heat source for the aggressive melt-concrete interaction stage.

IDCOR assumption (d) considers a pool of water over the debris, boiling at the critical heat flux. At the temperature specified for the debris, 2100 K, clearly this boiling regime would most appropriately be reprecented by film boiling. For most cases of interest in the NUREG-1150 analyses there would be no water present since containment sprays are assumed to not be available. The availability of fire sprays must be evaluated on a plant-specific basis. Regardless, the data base conclusively demonstrates that the appropriate boiling regime is film boiling.

IDCOR assumption (e) models heat transfer from the outer surface of the liner by radiation to the concrete shield wall and by convection to the gas in the narrow gap. The concrete and gas appear to be isothermal heat sinks at 350-400 K and the emissivities representative of blackbody radiation. However, the gap between the liner and concrete shield wall, at least for the Browns Ferry Nuclear Power Station analyses reported in Reference 6, is not empty but full of fibreglass and polyester foam. Over the time intervals reported in Reference 6 for liner failure, this would be sufficient to insure an adiabatic boundary condition on the outside surface of the liner, not a radiation-convection boundary condition. Also, the concrete would quickly heat up, effectively terminating heat transfer.

IDCOR assumption (f) assumes that an overlying pool of water exists over the core debris and that it cools the exposed surface of the liner with an effective heat transfer coefficient h_w. In most Mark I BWR drywells, the downcomer vents to the torus are only two feet above the drywell floor. If core debris were to accumulate to this depth, the overlying water pool would simply overflow into the suppression pool. This would prevent the water heat rejection mechanisms proposed, both for the liner and melt (debris) surface, and expose the liner to direct radiant heat transfer from the high temperature debris. In fact, molten core debris could easily overflow into the vents itself. *

IDCOR assumption (g) proposes a debris temperature of 1800 C and a debris depth of, at most, 12 cm. For similar low temperature cases studied in Reference 6, the steel liner was sometimes calculated to survive melt-through. However, the steel was calculated to be at a high enough temperature so as to have greatly reduced mechanical strength, and failure by mechanical deformation would be likely. Furthermore, a simple examination of the ex-vessel debris inventories calculated in recent studies such as BMI-2104, NUREG-1079, NUREG-0956, and NUREG-1150 indicate that debris depths (assuming uniform spreading over the entire drywell floor to minimize the depth) will exceed one foot.

Finally, IDCOR assumption (h) allows for heat transfer to underlying drywell concrete from the core debris by conduction only. By assumption, the concrete is not allowed to decompose or ablate. This is in spite of the fact that concrete needs only to be heated to 100 C to start boiling the free water in the aggregate matrix. By not accounting for debris-concrete interactions,

the gases (H_2O, CO_2) which would bubble up through the debris and react with metallic species (if there were any) are eliminated, thus erroneously precluding the possibility of exothermic chemical reactions in the melt. There is nothing in the existing data base to support the position that concrete behaves as a passive heat sink.

Other issues that may be imbedded in the IDCOR assumptions in Reference 8 but were not apparent to this assessment are the concepts that (1) water overlying molten core debris quenches that debris and (2) water on the floor presents an obstacle to the migration of high temperature melts across the floor. Data from ongoing experimental programs at SNL and BNL exist which contradict these concepts. Instead it is found that water overlying melts engages in film boiling and that melts flow through or under water obstacles as long as the debris is molten. Neither of these two concepts presents a convincing case to argue that core debris cannot flow to the containment liner and still be molten. ?

It is clear that there are major differences between the assumptions in the IDCOR analyses [8] and the BNL analyses [6] for the Mark I BWR containment liner response to contact with core debris. There are also major inconsistencies in the IDCOR model, particularly with respect to melt temperature and composition, boiling, concrete behavior, and liner-shield wall boundary conditions. The IDCOR analyses pertain only to a very limited, optimistic set of assumed accident conditions and are not generally applicable to a wide range of accident conditions such as those addressed in Reference 1. The IDCOR analyses specifically are not applicable under the conditions that (1) the debris pool is hot, molten, and deep, (2) the debris has a significant metallic component, (3) the debris is attacking the drywell basemat concrete, and (4) there are exothermic chemical reactions in the melt. In addition, some of the IDCOR models are suspect and should be reevaluated. In particular, (5) the heat transfer from the outer surface of the steel liner, (6) the existence of an overlying pool of water over the debris when containment sprays are not available, and (7) the mode of boiling of an overlying pool of water when water is available. Some of IDCOR assumptions with respect to physical properties should be reconsidered, specifically (8) radiative emissivities of steel, core debris, and concrete, and (9) the debris thermal conductivity.

Convection and radiation from the backside of the steel liner to the shield wall is to a constant temperature, infinite heat sink. This results in an increasing heat transfer with time as the liner heats up, instead of a decreasing heat transfer in time as the shield wall concrete heats up. No attempt to include the shield wall concrete in the analyses was made. This is puzzling since basemat concrete was explicitly included in the numerical model. It is not immediately apparent what the effect of this omission had on the numerical results. However, it is clearly in favor of liner survivability. It would be recommended that the shield wall be nodalized and more nodes employed in the steel liner. It is expected that implementation of these changes, along with relaxation of the previously listed objections, would

result in liner failure in the IDCOR analyses. A comparative assessment of both the IDCOR and NRC analysis approaches has revealed dramatic differences in several key features. These include:

- underlying assumptions
- initial conditions
- boundary conditions
- physical properties
- thermal-hydraulic models of key phenomena.

It is the opinion of the author that the existing data base supports the assumptions and approach used in the BNL analyses (Ref. 3,6) and not the IDCOR analyses (Ref. 8). Within the context of this assessment, there appears to be no defensible technical basis to support the IDCOR conclusions. As a result, it is once again concluded that the drywell liner is highly vulnerable to attack by ex-vessel core debris and that containment failure by melt-through is a highly probable mechanism of early containment failure.

4. ANALYSIS OF MARK I LINER RESPONSE TO CONTACT WITH SOLIDIFIED CORE DEBRIS WITH THE TAC-2D COMPUTER CODE

Staff of the NUREG-1150 Reassessment Program repeated the IDCOR liner analysis, relaxing certain questionable IDCOR assumptions/uncertainties, in order to determine if there was any merit to the IDCOR position.

The differences between the TAC-2D calculation and the IDCOR calculation were as follows:

- TAC-2D used a finer nodalization in the steel liner to better represent thermal gradients. It is believed IDCOR used 3 radial nodes.

- TAC-2D allowed for a metallic component in the debris as opposed to oxide fuel only. However, the debris was still all solid.

- TAC-2D did not have an overlying water layer. However, as discussed in Section 2, radiation and convection from the debris which was modeled in the TAC-2D calculation should be representative of heat fluxes expected by film boiling.

- The TAC-2D calculation replaced convection and radiation across the liner-shield wall gap by direct-contact conduction. The assumption made was that there was no resistance to heat transfer across the gap; but the TAC-2D calculation allowed for heat-up of the shield wall concrete as opposed to the IDCOR assumption that the shield wall was an infinite isothermal heat sink.

The similarities between the TAC-2D calculation and the IDCOR calculation were striking. This was due, of course, to the intention to reproduce the IDCOR analysis with a verified numerical tool with apparently defensible boundary conditions. Briefly, the similarities are as follows:

- Heat generation was at a level dictated, in both the oxide and metal layers, by decay heat.

- The analysis was a conduction analysis; no melt convection was allowed.

- There was no direct coupling to a MCCI analysis. In fact, concrete was treated as a passive heat sink. Concrete was not modeled to outgas, thus preventing exothermic metal-gas chemical reactions.

- The thermal loading on the steel liner could melt the steel, but the melted steel remained in place (not ablated).

The results of the SNL TAC-2D analysis did not indicate complete melt-through of the liner, however partial melting was observed in some calculations within 200 seconds of contact. The results indicated that peak temperatures in the carbon steel liner rapidly approached 1740K for the base case analysis, but minor increases in initial debris temperature resulted in substantial local melting. The preliminary conclusion was offered by the analyst that "reduced strength (of the steel liner) at elevated temperatures and significant melting calculated from small parametric variations strongly support the position that containment integrity is indeed compromised."

Thus, even with a conduction analysis, the TAC-2D calculations resulted in liner failure with minor changes from the IDCOR analysis.

It should be pointed out that the TAC-2D calculations allowed direct liner-shield wall contact. This would result, even with concrete melting, in a calculated outside liner boundary condition, biased towards the concrete ablation temperature, below the melting temperature of steel. It is the author's belief that inclusion of a minor heat transfer resistance between the liner and shield wall would have resulted in total melting of the liner in the TAC-2D calculations.

A series of TAC-2D calculations are presently being repeated with more parameters and reasonable assumptions, and the results will be available in the near future. At that time, the speculation concerning the effects of the parameters that have just been discussed may be relaxed.

5. CONCLUSIONS

There have been three numerical analyses performed to investigate the thermal response of the Mark I BWR drywell pressure boundary (a.k.a. steel liner, steel shell) to direct contact with core debris under severe accident conditions. Each of the three analyses, the BNL analysis (Ref. 3,6), the IDCOR analysis (Ref. 8), and the SNL analysis (unreferenced), has been described and critically reviewed. The bases for each analysis as well as the underlying assumptions have been discussed and examined for consistency and technical defensibility. A thorough review of the supporting data base has not been performed, however, where appropriate, experimental evidence which supports the positions developed in this report has been cited. For each analysis, the initial and boundary conditions, thermal hydraulic models, and physical properties have been discussed.

It was found that the BNL and SNL analyses resulted in rapid failure of the drywell pressure boundary, while the IDCOR analysis resulted in survival of the drywell pressure boundary. When the models and parameters of the IDCOR model which resulted in liner survival were reviewed, they were found to be inconsistent, and not supported by the data base. The SNL analysis, which relaxed only a few of the objectionable IDCOR assumptions and models while retaining the fundamental approach (i.e., conduction analysis), resulted in rapid failure of the steel containment. Inherent drywell design features were found to offer little or no support to the liner's ability to survive beyond the time of vessel failure. It is concluded that the drywell pressure boundary (steel liner) is vulnerable to even the most optimistic assumptions of in-vessel meltdown and transient melt ejection from the failed reactor vessel, and that primary containment failure by melt-through is a highly probable mechanism of early containment failure.

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APPENDIX A: MARK I CONTAINMENT DRYWELL: IMPACT OF CORE-CONCRETE INTERACTIONS ON CONTAINMENT INTEGRITY AND FAILURE OF THE DRYWELL LINER (REFERENCE 6).

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IMPACT OF CORE-CONCRETE INTERACTIONS IN THE MARK I CONTAINMENT DRYWELL ON CONTAINMENT INTEGRITY AND FAILURE OF THE DRYWELL LINER

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Impact of Core-Concrete Interactions* in the Mark I Containment Drywell on Containment Integrity and Failure of the Drywell Liner

ABSTRACT

Previous containment analyses of the Mark I BWR have considered the γ-mode of containment failure as the dominant mode. The γ-mode is over-pressure failure of the drywell liner resulting in release of fission products and aerosols directly into the reactor building. The failure pressure for this event has been estimated at 132 psia. However, results from the SASA program analyses of the Mark I BWR have indicated that high temperatures in the drywell during ex-vessel core-concrete interactions may result in containment failure due to seal degradation prior to gross failure due to over-pressurization. It has become evident that a third mode of drywell failure must be considered under these specified accident conditions, in addition to the gross over-pressure failure and the leak-before-failure modes. This third mode of failure is local ablation of the steel drywell liner due to contact with the molten corium. In order to assess the drywell liner response to heat transfer from a pool of molten core debris during a core-concrete interaction, a calculational procedure consisting of both code calculations and hand calculations was developed. The general methodology was to calculate the melting attack on the steel liner by molten core debris that is simultaneously attacking the drywell concrete floor.

A comparison of the results of the calculations indicates that all three containment failure modes need to be considered simultaneously in order to accurately predict the pressure-temperature history in a Mark I BWR drywell. Leakage through drywell seals, as well as through local breaches in the liner due to melting, must be considered when estimating the structural response of the drywell. The transport of fission products and aerosols will also be affected by the location and timing of containment failure, as well as mode of failure, leakage area, and flow rate through the leakage area.

1. INTRODUCTION

The potential for containment failure from core melt accidents has been under review by the Nuclear Regulatory Commission (NRC) for some time. The possibility of early failure with the

*Work performed under the auspices of the U.S. Nuclear Regulatory Commission.

potential for a large release of radioactivity (aerosol concentration is higher early in the accident) is the principle reason for this attention. Containment loads that might lead to such failure can result from severe accidents not normally considered in the design basis of nuclear power plants. In order to assess the inherent capability of various containment designs to mitigate the effects of a broad range of severe accidents, the NRC formed the Containment Loads Working Group (CLWG) with the objective of developing an updated evaluation of containment loads (temperature and pressure history) and associated challenges to containment integrity.

The overall approach was based on a standard problem methodology. The CLWG management team selected a specific reactor to represent each of the six containment designs deployed in the U.S. These were chosen to overlap with previous probabilistic risk assessments in order to provide a basis for evaluating progress in understanding severe accident phenomena.

This paper is an outgrowth of the BNL and ORNL participation in the CLWG and specifically deals with the likely failure mechanisms for Standard Problem 4 (SP-4).

The Containment Loads Working Group (CLWG) Standard Problem 4 is a TQUV-type accident sequence in a Mark I BWR containment in which all coolant injection fails at the time of reactor SCRAM from 100% power. Without coolant injection, the core uncovers within 30 minutes and since the ADS is assumed not activated, the primary system remains at high pressure. Shortly, the uncovered core of the reactor begins to melt, slumps into the RPV lower plenum, and eventually causes the reactor lower head to fail at approximately three hours after accident initiation. The molten corium is assumed to be displaced onto the reactor containment drywell floor immediately and to begin to attack the drywell concrete.

The Mark I containment consists of the drywell, pressure suppression pool, downcomer vents connecting the drywell and suppression pool, a containment cooling system, isolation valves, etc. The drywell is a steel pressure vessel, cylindrical at the top and spherical at the bottom. The vent system to the wetwell has eight circular downcomer pipes which penetrate the steel drywell liner, terminating in the pressure suppression pool. The pool is a toroidal steel pressure vessel which contains subcooled water for condensing primary system steam during normal transients.

The particular containment design chosen for Standard Problem 4 was that of the Browns Ferry Nuclear Power Station. In this containment, the molten core debris, consisting of approximately 80% of the core inventory, is assumed to fall downward into the reactor pedestal region forming a deep pool, filling the two containment sumps, and then flowing outward through the doorway over the annular drywell floor area. The sump volumes

are approximately 3.8 m^3. Subtracting this from the initial corium inventory of 32.3 m^3 leaves 28.5 m^3 to be spread over a total of 132 m^2 of floor area. Assuming an even spread of all the debris over the entire floor results in a corium pool depth of 22 cm. Although this spreading is not mechanistically calculated, it is considered reasonable for the limiting high temperature debris case since pathways through the many obstructions are available, and there is empirical evidence that corium will flow at depths characteristic of this calculation [1]. For the high temperature limiting case, it is assumed that the debris will spread up to the steel containment liner itself.

Previous containment analyses of the Mark I BWR [2] have considered the γ-mode of containment failure as the dominant mode. The γ-mode is over-pressure failure of the drywell liner resulting in release of fission products and aerosols directly into the reactor building. The failure pressure for this event has been estimated at 132 psia [3]. However, recent results from the SASA program analyses of the Mark I BWR have indicated that high temperatures in the drywell during ex-vessel core-concrete interactions may result in containment failure due to seal degradation prior to gross failure due to over-pressurization [4,5,6]. Recent efforts by the Containment Performance Working Group (CPWG) have concentrated on determining the probability and timing of over-temperature failure of these penetrations, and the rate of leakage into the reactor building [7].

It has become evident that a third mode of drywell failure must be considered under these specified accident conditions in addition to the gross over-pressure failure and the leak-before-failure modes. This third mode of failure is local ablation of the steel drywell liner due to contact with the molten corium. Since pathways through the obstructions on the drywell floor are available, molten core debris is assumed to flow outward from the pedestal region and contact the drywell liner. As long as the corium is at a temperature greater than the steel melting temperature, it will present a threat to the containment integrity due to local melt-through. Should this occur, a flow path to the reactor building and standby gas treatment system, bypassing the wetwell, will be available for blowdown of the high temperature concrete decomposition gases from the ex-vessel core-concrete interaction, aerosols, and volatile fission products. Although some of the gap between the drywell liner and the concrete is filled with fiberglass and polyester foam (see Figure 1), it is doubtful that they will present a significant obstacle to the flow of these high temperature gases from the drywell.

The objectives of this study are to:

(1) Develop a methodology to calculate the attack of molten core debris on the drywell liner,

(2) Parametrically study the impact of corium temperature, concrete composition, and fraction of core in corium on liner melt-through, and

(3) Compare the results to over-pressure and over-temperature failure times for a Mark I BWR.

2. PROBLEM SPECIFICATIONS FOR SENSITIVITY STUDIES

The CLWG Standard Problem 4 addresses the timing of the failure of the drywell due to over-temperature soaking of penetration seals (leak-before-fail) versus gross over-pressure failure of the steel liner (γ-mode failure). For SP-4, the core debris temperature and composition, the concrete composition, and the fraction of the core released were specified [8,9]. The specifications of the corium and concrete compositions as well as a summary of the sensitivity calculation specifications for SP-4 are listed in Tables 1 and 2, respectively.

The approach taken in the local liner failure calculations was somewhat different than for the SP-4 calculations reported in the CLWG report [10]. For SP-4, radiative heat transfer from the surface of the corium debris to the drywell containment structures and atmosphere was eliminated. All the sensible energy in the debris was thus forced into ablation of concrete, maximizing the concrete erosion rate and the generation of concrete decomposition gases. For the local liner failure calculations, however, radiative heat transfer from the corium debris surface was modeled. This enabled a more accurate calculation of the transient corium temperature, the most important variable in the calculation of the liner ablation rate. The concretes that were used in the calculations were a basalt- and a limestone-type, identical in composition to those specified for SP-4. The actual concrete composition at Browns Ferry is approximately an average of these two generic concretes (see Table 1). Three core debris temperatures were assumed: 2550 K, 1900 K, 1775 K. Mechanistically, the low temperature debris case is inappropriate since the debris probably would not be able to flow to the liner prior to solidifying. The radius of spreading of the debris on the drywell floor was assumed to be approximately 7 meters and the depth of the debris was held uniform. The debris required to fill the drywell sumps was subtracted from the debris inventory in order to calculate the corium depth. The radiative emissivity of the corium was given a constant value of 0.5. The fraction of the core that was allowed to participate in the core/concrete interaction was assumed to be 80% or 60%.

Although the TQUV accident sequence is a high pressure sequence with failure of the ADS, this was assumed to have no impact on the disposition of the corium in the drywell upon failure of the RPV. In other words, the debris was allowed to spread uniformly and homogeneously across the floor; high pressure jetting, impaction on the steel liner, and direct

atmospheric heating were neglected. Although modeling of these phenomena may be desirable, they were neglected since they were beyond the scope of this study. A complete list of the parametric calculations chosen for the local liner melt-through evaluations is shown in Table 3.

3. CALCULATIONAL MODEL

In order to assess the drywell liner response to heat transfer from a pool of molten core debris during a core-concrete interaction, a calculational procedure consisting of both code calculations and hand calculations was developed. The general methodology was to calculate the melting attack on the steel liner by molten core debris that is simultaneously attacking the drywell concrete floor. The calculational tool that was used to analyze the attack of molten core debris on the drywell concrete floor was a modified version of the CORCON-MOD1 computer code [11].

CORCON-MOD1 is a general model describing the thermal and chemical interactions between molten core debris and structural concrete. The major components of the system are the concrete cavity, the molten debris pool, and the gas atmosphere and surroundings above the pool. The geometry of the system is formulated as a two-dimensional, axisymmetrical cavity, although specific geometries not available as code-supplied options may be user-input.

From the results of the CORCON code calculations, the maximum sidewards heat transfer coefficient across the gas film to the ablating concrete, h_i, was calculated at each time step as

$$h_i = \frac{q''_{conv} + q''_{rad}}{T_{interface} - T_{abl,concrete}}$$

where q''_{conv} and q''_{rad} are the convective and radiative components of heat transfer per unit area across the gas film, and $T_{interface}$ and $T_{abl,concrete}$ are the melt-gas film interfacial temperature and the concrete ablation temperature, respectively. This heat transfer coefficient was then used as input for the calculation of the transient heat-up and ablation of the steel liner. The heat transfer from the molten corium to the steel liner was modelec as one-dimensional transient convection with sensible and latent heat transfer. The transient heat-up of the liner from its initial temperature to the steel melting temperature was calculated as

$$(\rho c)_{steel} V \frac{dT_{steel}}{dt} = h_i(T_i - T_{steel})A$$

subject to the initial condition

$$T_{steel}(t=0) = T_0 = 300 \text{ K}$$

where ρ is the steel density, c is the specific heat, V is the liner volume, and A is the contact area of the liner with the molten core debris. Note that V/A is the liner thickness, δ. Once the liner is calculated to have heated to its melting temperature of 1750 K, the rate of melting of the steel liner is calculated until the calculational procedure is terminated. The melt rate of the liner is calculated as follows:

$$\rho_{steel} h_{fs,steel} \frac{d\delta}{dt} = h_i(T_i - T_{ablate})$$

subject to the initial condition

$$\delta(t = t_0) = 3 \text{ cm}$$

where h_{fs} is the latent heat of the steel, T_{ablate} is the steel ablation temperature, and t_0 is the time at the start of the ablation calculation.

The calculation proceeds until one of three criteria are satisfied. First, the calculation is terminated when the thickness of steel ablated exceeds the initial liner thickness. This time, t_{ablate}, indicates the containment failure time at which the fission products and aerosols would flow into the gap between the liner and shield wall, eventually finding their way into the reactor building. The second criterion which will terminate the calculation is when the downward erosion depth into the concrete exceeds the bubbled-up depth of the corium against the steel liner. Once the erosion depth exceeds the corium pool depth, it is assumed that contact of the corium with the steel is ended and the threat to the liner is over. If the liner is not penetrated at this time, it is not estimated to fail by melt-through. The third criterion for termination of the calculation is when the calculated corium-steel interfacial temperature falls below the steel melting temperature. Once this occurs, melting of the liner ends and failure by melt-through is avoided. Some of the physical properties and physical constants used in the calculations to be discussed are listed below:

ρ_{steel} = 8000 kg/m^3,
$h_{fs,steel}$ = 2.7×10^5 J/kg,
c_{psteel} = 500 J/kg K,
δ_{wall} = 3 cm .

4. RESULTS OF PARAMETRIC CALCULATIONS

The results of the calculations that were performed for the local liner failure problem are indicated in Table 4. Indicated on the table are the concrete type, corium temperature, percent of core participating in the interaction, total time to fail liner, total downward erosion at end of calculation, and thickness of liner ablated. It is clear from the table that in most cases studied, the steel liner was calculated to fail by ablation very rapidly, in one case as rapidly as 3-1/2 minutes after contact with the molten core debris. In two of the eight cases studied, it was calculated that the liner would not fail by local melt-through at all. This occurred for the 1775 K and 1900 K corium temperature cases on the basaltic concrete. Due to the low ablation temperature assumed for the basaltic concrete cases (≈1450K), the corium temperature dropped quickly upon contact since the basaltic concrete acts as a rapidly ablating, low temperature heat sink. As a result, the corium debris fell very rapidly below the steel ablation temperature, 1750 K, ending the ablation of the liner early. If at this time the liner had not been calculated to have been penetrated, it was assumed that no further threat by local melt-through would occur and the calculation was terminated. The only basalt concrete cases in which the drywell liner failed by melt-through were for the high corium temperature cases of 2550 K. For these two cases, it took only 5-1/2 minutes to ablate the liner and fail the drywell.

For all the limestone concrete cases studied, the steel drywell liner was calculated to melt through rapidly. The time to melt through varied from 3-1/2 minutes for the 2550 K corium cases to 45 minutes for the 1775 K corium case. Once again as for the 2550 K basalt cases, varying the percent of the core from 80% to 60% had little impact on the failure times. Since the ablation temperature of the limestone-type concrete was assumed to be 1750 K, the same as the melting temperature of the steel liner, the debris remained slightly above this temperature long enough to insure the eventual melt-through failure of the drywell liner, even for the case that the debris initial temperature was 1775 K.

It is apparent from these results that variation of the fraction of core in the core-concrete interaction had no impact on the ablation rate for both the high debris temperature limestone and basalt concrete cases. In none of the calculations did the corium debris penetrate deep enough into the concrete to terminate the calculations.

It is not clear if assigning the same ablation temperature to both the limestone concrete and the steel liner had any impact on the results of the low temperature limestone concrete-liner failure calculations. It would be desirable to lower the concrete ablation temperature by 25 K to determine if it would lower the debris temperature below the steel ablation temperature in time to prevent failure of the drywell by melt-through, in much the same way the basalt concrete calculations behaved. It is clear, however, that the only cases that liner failure by melt-through was avoided were those for which the corium debris temperature fell below 1750 K prior to liner melt-through.

5. DISCUSSION OF RESULTS

Until recently, the most likely modes of containment failure in a Mark I BWR were considered to be over-pressurization of the drywell and structural failure of the drywell liner or failure of sealing materials due to degradation at elevated temperatures and leakage through these degraded seals into the reactor building.

It is now apparent that if the Mark I containment is going to fail under the threat presented by an ex-vessel core-concrete interaction, it may occur early in the interaction due to melt-through of the steel drywell liner if the core debris is able to flow to and ablate the liner. In some cases, the drywell liner was calculated to fail within five minutes of contact with molten core debris, taking as long as 45 minutes in one case. In only two cases, with relatively low temperature debris interacting with a highly basaltic concrete, was the liner calculated to survive.

A comparison of calculated or estimated drywell failure times (time after RPV failure) for these three failure modes discussed is presented in Table 5. The calculations are for a TQUV accident sequence in a Browns Ferry-type Mark I containment with no CRD flow. In these calculations, the containment response calculations were performed with the MARCH 1.1B computer code [12] developed at ORNL, which contains some modeling changes specific to the Mark I not available in MARCH 1.1 [13]. The containment failure results which are presented employed CORCON-MOD1 calculations which were input to MARCH 1.1B in tabular form, bypassing the INTER model [14] in MARCH, which has been shown to overpredict concrete erosion rates and gas generation rates during core-concrete interactions.

The containment leakage times quoted in Table 5 are estimated from Reference [7] using the pressure-temperature histories from Reference [10]. Using the medium pre-existing leak area results for ethylene propylene seal material at 500 F, the seal soak time to initiate leakage is 13 minutes and the ramp time to totally degrade the seal material is 16 minutes. The over-temperature failure times listed indicate the sum of the

times to achieve ~500 F in the drywell atmosphere is an additional 34 minutes. All times listed in Table 5 are "time after RPV failure."

Note that the over-pressurization failure times vary from over two hours for CLWG Case 1 to over eight hours for Cases 2 and 3. Case 4, with an extrapolated over-pressure failure time of 16 hours, is considered highly unlikely to actually fail the containment at all on pressure. The over-temperature failure times from the CPWG criteria are significantly shorter, varying from one hour for Case 1 to 3-1/2 hours for Case 2. Cases 3 and 4 are not calculated to fail at all on over-temperature. However, the local liner melt-through calculations indicate that failure may be expected as early as 3-1/2 to 5-1/2 minutes after the initiation of ex-vessel core-concrete interactions for Cases 1 and 3, to as much as 45 minutes for Case 2. These times are much less than the failure times for either of the other two failure modes. Case 4 was not calculated to melt through the liner.

What is evident from this comparison is that all three containment failure modes need to be considered simultaneously in order to accurately predict the pressure-temperature history in a Mark I BWR drywell. Leakage through drywell seals as well as through local breaches in the liner due to melting must be considered when estimating the structural response of the drywell. The transport of fission products and aerosols [16] will also be affected by the location and timing of containment failure, as well as mode of failure, leakage area, and flow rate through the leakage area.

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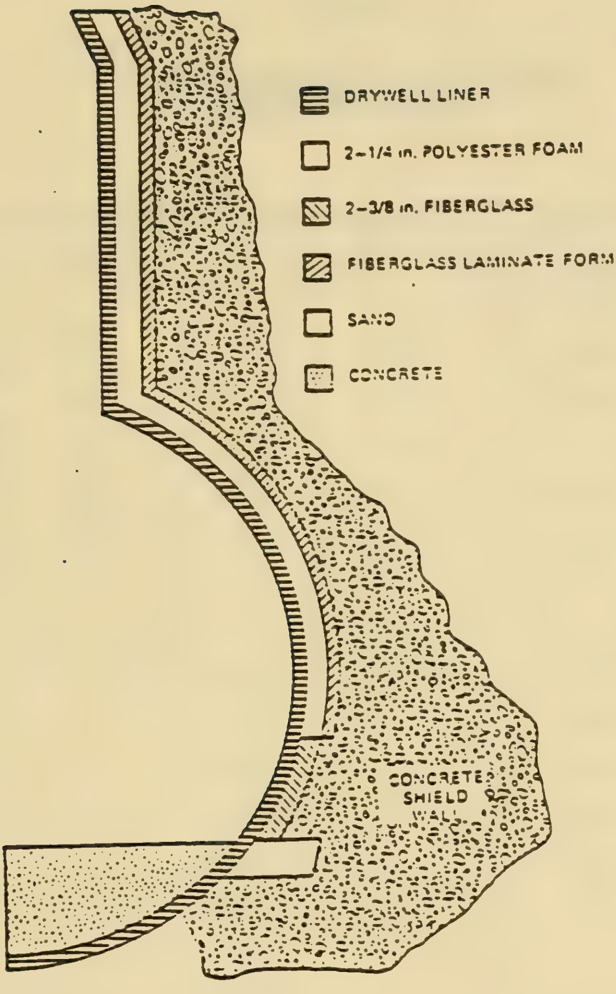

Figure 1 Drywell Liner - Concrete Shield Wall Gap Geometry (ORNL-DWG 83-4244 ETD)

TABLE I

SPECIFICATION OF CORIUM AND CONCRETE COMPOSITIONS FOR SP-4

CONCRETE	LIMESTONE	BASALT	BROWNS FERRY
WEIGHT FRACTIONS:			
$CaCO_3$	0.80	0.01	0.45
$Ca(OH)_2$	0.15	0.13	0.07
SiO_2	0.01	0.57	0.39
Free H_2O	0.03	0.04	0.05
Al_2O_3	0.01	0.20	0.04
CORIUM			
UO_2	127000 kg		
ZrO_2	9150 kg		
FeO	12230 kg		
Fe	41920 kg		
Zr	45380 kg		
Ni	4250 kg		
Cr	8000 kg		

TABLE II

SUMMARY OF SENSITIVITY CALCULATION SPECIFICATIONS FOR SP-4

Case Number	1	1a	2	3	3a	4
Corium Spread (m)	5	5	3	5	5	3
Debris Temperature (K)	2550	2550	1755	2550	2550	1755
Concrete Type	L	L	L	B	B	B
Free H_2O (%)	3	6	3	4	8	4
Steel in Corium (lb)	140K	140K	140K	140K	140K	140K

TABLE III

MATRIX OF BWR MARK I LOCAL FAILURE CALCULATIONS

CASE NUMBER	1	2	3	4	5	6	7	8
Corium Spread (m)	6	6	6	6	6	6	6	6
Debris Temperature (K)	1775	1775	1900	1900	2550	2550	2550	2550
Concrete Type	B	L	B	L	B	L	B	L
Corium Fraction (%)	80	80	80	80	80	80	60	60
Corium Composition	See Table 1							

TABLE IV

SUMMARY OF BWR MARK I LOCAL FAILURE
CALCULATION RESULTS

RUN	CONCRETE*	CORIUM TEMPERATURE (K)	% OF CORE	TIME TO FAIL LINER(s)	AXIAL+ CONCRETE EROSION (cm)	THICKNESS+ OF LINER ABLATED (cm)
1	B	1775	80	NO MELT-THROUGH	3.3	0.1
2	L	1775	80	2842	1.2	3.0
3	B	1900	80	NO MELT-THROUGH	7.4	0.3
4	L	1900	80	895	1.5	3.0
5	B	2550	80	328	4.0	3.0
6	L	2550	80	208	1.6	3.0
7	B	2550	60	325	3.6	3.0
8	L	2550	60	226	1.6	3.0

* B = Basalt, L = Limestone

\+ At liner melt-through time.

TABLE V

COMPARISON OF APPROXIMATE DRYWELL FAILURE TIMES
BY OVER-PRESSURE, OVER-TEMPERATURE, AND LINER MELT-THROUGH

CLWG CASE	DEBRIS TEMPERATURE CONCRETE COMPOSITION	MAXIMUM DRYWELL† P AND T	CLWG OVER-PRESSURE FAILURE (MIN)	CPWG OVER-TEMPERATURE FAILURE (MIN)	LINER MELT-THROUGH FAILURE (MIN)
1	2550 K, Limestone	145 psia 622K(660F)	133	62	3.5
2	1755 K, Limestone	88 psia 533K(500F)	500*	329	45
3	2550 K, Basalt	108 psia 477K(400F)	460*	No Leakage Calculated	5.5
4	1755 K, Basalt	65 psia 411K([illegible])	950* Failure Unlikely	No Leakage Calculated	No Melt-Through Calculated

* Extrapolated value.
† Maximum during five hours of core/concrete interaction.

APPENDIX B: APPROXIMATE SOURCE TERM METHODOLOGY FOR BOILING WATER REACTORS, FAI/86-1 (REFERENCE 8).

DRAFT

FAI/86-1

APPROXIMATE SOURCE TERM METHODOLOGY FOR BOILING WATER REACTORS

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DECEMBER, 1986

APPENDIX D

Estimates of the Containment Ultimate Pressure Capacity and the Failure Modes

The assessment of containment ultimate pressure has two different purposes depending upon whether procedures for a sufficient containment vent have been implemented for the various accident classes. For those designs with containment venting procedures implemented, the assessment for containment integrity is directed toward assuring that the containment integrity would be assured until the venting pressure is achieved. For such cases, a sophisticated calculation for the ultimate capacity of the containment liner, rebar and/or tendons is not required. The user can use the conclusions drawn from IDCOR Task 10 report (D-1) which concluded that the ultimate containment capacity is at least twice the design value and usually about 2.5 times the design pressure. A more sophisticated analysis would only be required if the pressure for initiating containment venting is higher than twice the containment design pressure.

However, additional evaluations should be carried out to insure that there are no obvious regions associated with the containment penetrations that would fail before the containment venting pressure would be reached. Areas which have been identified in the past which should be surveyed to insure that such failures would not be anticipated are listed in Table D.1. This provides a checklist for the various areas to be surveyed is included as a guide for the user.

For those designs or specific sequences where containment venting may not be available, the assessment of containment ultimate capacity should include an evaluation of the containment ultimate pressure including the penetrations, to evaluate both the timing and the location of the potential failure. For Mark I and Mark II systems, this assessment should include the structural capacity of the drywell and the wetwell while also assessing the potential failure at penetrations in each of these regions when the containment is strained close to the ultimate failure conditions. Table D.2 lists the assessments which should accompany the vulnerability evaluation for

Table D.1

NECESSARY ASSESSMENTS FOR CONTAINMENT INTEGRITY
WITH IMPLEMENTED PROCEDURES FOR WETWELL VENTING

The following areas should be examined to insure that containment integrity would not be challenged by overpressure before the containment venting pressure is reached.

	Mark I	Mark II	Mark III
Drywell Ultimate Pressure	Only if $P_{vent} > 2P_{design}$	Only if $P_{vent} > 2P_{design}$	-
Wetwell Ultimate Pressure	Only if $P_{vent} > 2P_{design}$	Only if $P_{vent} > 2P_{design}$	Only if $P_{vent} > 2P_{design}$
Hot Penetrations (Steamlines)	✓	✓	✓
Cold Penetrations (Feed-water and ECCS Lines)	✓	✓	✓
Personnel Hatches (and Manways)	✓	✓	✓
Equipment Hatch	✓	✓	✓
Purge Lines and Purge Valves	✓	✓	✓
Electric Penetrations	✓	✓	✓

Table D.2

NECESSARY ASSESSMENTS FOR CONTAINMENT FAILURE MODE

The following areas should be examined to estimate the containment ultimate pressure and location due to overpressure.

	Mark I	Mark II	Mark III
Drywell Ultimate Pressure	✓	✓	-
Wetwell Ultimate Pressure	✓	✓	✓
Hot Penetrations (Steamlines)	✓	✓	✓
Cold Penetrations (Feed-water and ECCS Lines)	✓	✓	✓
Personnel Hatches (and Manways)	✓	✓	✓
Equipment Hatch	✓	✓	✓
Purge Lines and Purge Valves	✓	✓	✓
Electric Penetrations	✓	✓	✓

containment failure. These should use the analyses in IDCOR Task 10 for guidance. The Mark III containment systems need only evaluate the potential for failing below the suppression pool water line in comparison to failures above this location since a failure above the suppression pool water line would allow the fission products to be scrubbed through the suppression pool even after containment failure and a detailed assessment of such source terms is unnecessary.

THERMAL RESPONSE OF THE STEEL CONTAINMENT SHELL

The response of the Mark I steel containment shell following release of core material from the reactor vessel is dependent upon (1) the mass of core material involved, (2) the temperature of the debris and the presence of water in close proximity to the debris and the steel shell. To analyze the shell transient response, a finite difference model was constructed representing the two-dimensional conduction within the steel shell and the supportive concrete inside and outside the shell. Since the large differences in the thermal properties between the carbon steel and the oxide fuel greatly favor the steel, core debris would be frozen upon contact with the shell. As a result, the regions close to the steel responsible for localized heating, would be the frozen crust and the molten material next to the crust, with the major energy transfer process being conduction controlled in the debris crust. This has been demonstrated experimentally in Reference (1). Thus, the core material was also nodalized such that the two-dimensional conduction process into the shell and the concrete floor could be represented. Quenching of the debris, which would occur with an overlying water pool, was also represented in the model. Figure 1 illustrates the general nodalization scheme used, with the major processes being two-dimensional conduction in the debris and the steel shell as well as quenching with the overlying water pool.

Upon contact with the steel shell, the interface between the debris and the steel will establish an initial temperature (T_1) given by

$$T_1 = \frac{T_{Fo} + \sqrt{\frac{k\rho c)_S}{k\rho c)_F}}\, T_{So}}{1 + \sqrt{\frac{k\rho c)_S}{k\rho c)_F}}} \qquad (1)$$

where T_{Fo} is the initial core debris temperature, T_{So} is the initial temperature of the steel shell, ρ, c and k are the density, specific heat and thermal conductivity of the core debris (subscript F) and steel (subscript S). This temperature would remain constant until the thermal wave penetrated either the steel shell or the debris configuration, whichever occurred first. In the nodalization scheme, this temperature is used to control the heat flux into the inside surface node of the steel shell until the first nodal temperature achieves a temperature such that the interfacial

temperature is best described by the equal flux gradients between the steel and fuel nodes. This condition is given by

$$T_i = (k_F T_{Fi} + k_S T_{Sj})/(k_F + k_S) \tag{2}$$

where T_{Fi} is the temperature of debris node i and T_{Sj} is the temperature of steel node j.

Nodalization

The finite difference model used the nodalization scheme shown in Figure 1, with three major regions to describe the containment shell, two regions for the concrete and one for the core debris. Containment shell regions include that part which is in direct contact with the debris, the region above the contact zone and the region imbedded in the concrete. The two concrete regions modeled are: (1) the inside of the shell which is also in contact with the debris and (2) the outside of the containment shell. Each of the six major regions is subnodalized as illustrated in Figure 2, which allows the two-dimensional temperature profiles in each region to be calculated. The nodalization scheme is established in the upper and lower steel nodes for a length equal to three times the debris depth and in the concrete nodes to a length of three times the shell thickness in a direction orthogonal to the shell. This is sufficient such that the most remote nodes can be assumed to have adiabatic outer surfaces without influencing the calculation. As stated above, the core debris region considers that a layer of water may cover the debris, which could quench the overheated debris from above. In this regard, it is important that the debris be nodalized in a two-dimensional manner since the debris is close to the containment shell would experience an initial thermal transient due to direct contact with the shell. As a result, this region could quench faster since the localized stored energy would be substantially less than that originally contained in the debris.

In addition, the upper steel node above that portion in direct contact with the core material should consider convective energy losses to the overlying water pool as well as convective and radiation losses off of the outer containment shell surface. Since the carbon steel containment shell has a high thermal conductivity, the regions above and below that in contact with the debris would be effective fins to conduct away much of the imposed heat transfer. This is particularly true when there is an overlying water pool since the upward conduction length would be very short with convective (boiling) heat losses to the water pool.

The calculations were checked in two ways. The first was to perform a global energy balance on the three steel shell and two concrete regions given the imposed heat flux from the overheated core debris and the heat losses at all of the available surfaces. The second was to perform a global energy balance on the core debris given the heat flux to the steel and concrete regions as well as the internal heat generation due to decay heat and the quenching of material by overlying water. For both energy balances, the integrated energy transfer to and from the regions were compared to the

summation of the stored energy in all subnodes and the energy excess or decrement with respect to the initial condition. Both showed good agreement through the entire transient evaluated.

Results

Using the model, the wall thermal response for conditions when water would, and would not be available, were analyzed to show the thermal response of the drywell shell. One of the variables controlling the shell thermal response is the depth of the core material in intimate contact with the shell. Other features analyzed using the model are the influence of initial debris temperature, which should also be included in the decision making, the extent of the nodalization the influence of an overlying water pool and the influence of a protective layer on the inner steel shell surface.

Figure 3 illustrates the thermal response of the hottest steel shell node for initial conditions of 2100°K debris temperature, 0.12 m debris depth, which represents approximately 50% of the core material discharged from the reactor vessel at vessel failure, and no overlying water pool. As illustrated, the temperature increases over approximately 200 seconds to a value of about 800°K (980°F). Figure 3 also illustrates the response of the hottest steel node for the same initial conditions except with water available. As shown, the original temperature increase for this node is essentially the same as that calculated without water but after about 200 seconds, quenching of the core material occurs and the temperature is dramatically reduced. Figure 3 also illustrates the thermal response with water available and an increased pressure in the containment as a result of the accident scenario. In particular, the figure considers cases in which the containment pressure is 0.1 MPa (1 atm), 0.3 MPa (3 atm) and 0.5 MPa (5 atm). As shown, the increased drywell pressure, which provides for an increased quenching rate, significantly effects the containment shell thermal response because the higher quenching rate cools the debris sufficiently rapidly that the steel nodes do not achieve the peak temperature. This is a particularly informative result since the threat to containment integrity would only arise from a substantial pressure difference across the containment shell and this pressure difference would also mean that a significant increase in the quenching rate would be available. Consequently, it is important to consider the containment shell integrity in terms of both the stress applied to the shell by the internal pressure as well as the influence on the debris quenching rate. In this regard, the presence of drywell sprays would provide the quenching capability and at the same time would reduce the drywell pressure through condensing steam and cooling the noncondensable gases. Both of these act to protect the shell integrity.

These analyses illustrate several key features pertinent to the evaluation of the containment shell response.

o First, they illustrate that the thermal inertia of the shell is very significant and that the initial thermal transient between high temperature core debris and the carbon steel shell would be strongly weighted in favor of the shell. This means that the thermal transient would be much greater in the low thermal

conductivity core material than in the containment shell. Consequently, direct contact by the core debris would not directly fail the containment shell but would provide for a thick crust formation of core material that could further insulate the steel shell. This crust formation would occur virtually instantaneously because of the large differences in the thermal conductivity ($k \sim 3.3$ W/m°K for debris and 66 W/m°K for carbon steel).

- Secondly, the peak steel temperature is not achieved until about 100 seconds of direct contact. This implies that the dynamics of the core material discharge process, which would take place over a few seconds to a few tens of seconds would be relatively unimportant. Consequently, the appropriate modeling configuration is one in which the debris has settled against the containment shell.

- Thirdly, since the appropriate debris configuration is one which has settled, regions which were exposed to high temperature core debris as a result of the dynamics of the debris distribution process and caused a localized frozen crust to be formed on various structures including the containment shell, would not be exposed to continued heating by molten core material since this would drain to a lower portion of the drywell. As a result, the frozen crust would be the only heat generating material which could increase the temperatures of the local structures and this would be a negligible energy source compared to the energy dissipation capabilities of the high conductivity steel structure.

- Fourthly, the settled debris configuration could be that due to molten core material or solidified debris. For molten material, the appropriate depth of material is represented by uniform distribution and the initial temperature should be that representative of the debris discharged from the reactor vessel. Deeper debris depths would only be possible with solidified material which would have a substantially lower temperature. Therefore, in dealing with the peak temperatures of the steel structure, the depth of core material cannot be considered to be independent of the initial temperature. Figure 4 illustrates the thermal history of the hottest shell node for different debris depths. As shown, the depth changes the temperature at 200 seconds by about 150°C when quenching is not considered. For accumulations which would be anticipated under severe accident conditions at Pilgrim, the peak wall temperature would be about 700°K (800°F).

Another aspect of these analyses is the strong temperature gradients developed along the length of the steel shell. The highly nodalized model shows that there is little temperature difference through the steel shell, but the upward heat losses to an overlying water pool and the conduction losses to the steel imbedded in concrete cause a strong axial temperature variation. As a result, the region which is overheated is less than one half of the debris depth, i.e. at most a few centimeters. As a result, this region

would experience some deformation, but would receive substantial structural support from colder regions above and below the high temperature zone.

Analyses were also performed for a 1 cm thick concrete barrier on the inside of the containment shell. As shown in Figure 5, this decreases the thermal transient by about 150°C (250°F). A major consideration for the barrier would be the method of anchoring the liter concrete in the presence of the dense core debris. It should also be noted that the presence of a debris barrier does not alter the conclusion that water should be added to quench the debris and prevent concrete attack.

In summary, the analyses assumed a conservative condition of debris coming into direct contact with the containment shell. No early failures of the shell would be expected as a result of this contact and water has been demonstrated to quickly quench the debris. It should also be noted that water (drywell sprays for example) would tend to inhibit or prohibit such direct contact from occurring.

<u>Reference</u>

(1) M. Epstein, et al., "Transient Freezing of a Flowing Ceramic Fuel in a Steel Channel", Nuc. Sci. and Eng., 61, 1976, pp. 310-323.

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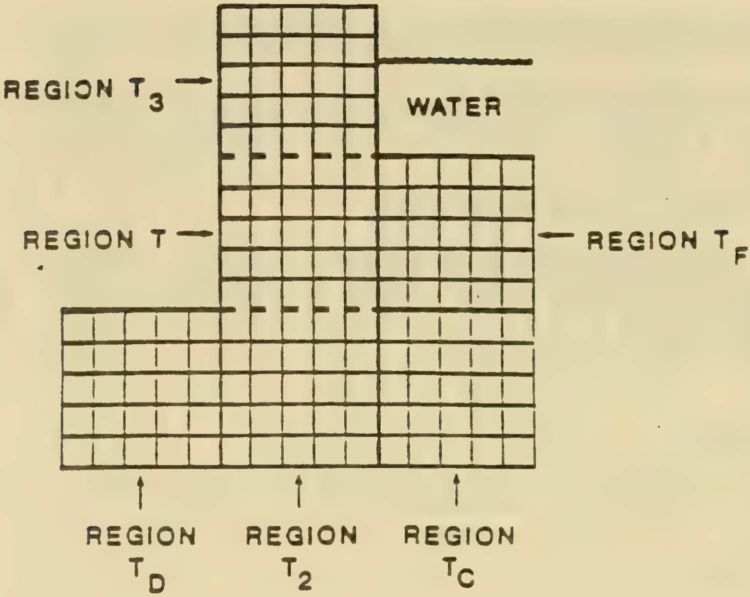

Figure 2 Subnodalization scheme.

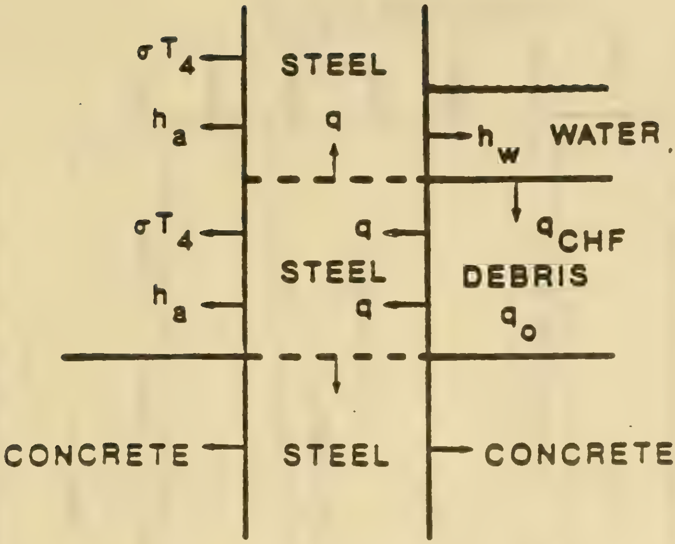

Figure 1 General nodalization scheme.

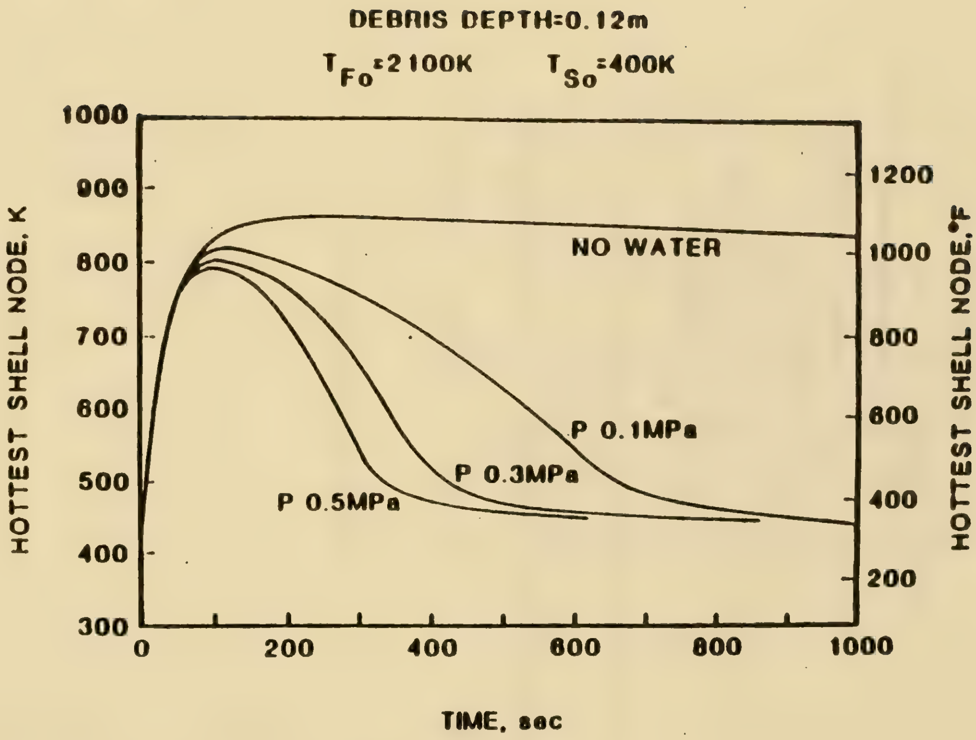

Figure 3 · Thermal response of the hottest steel node.

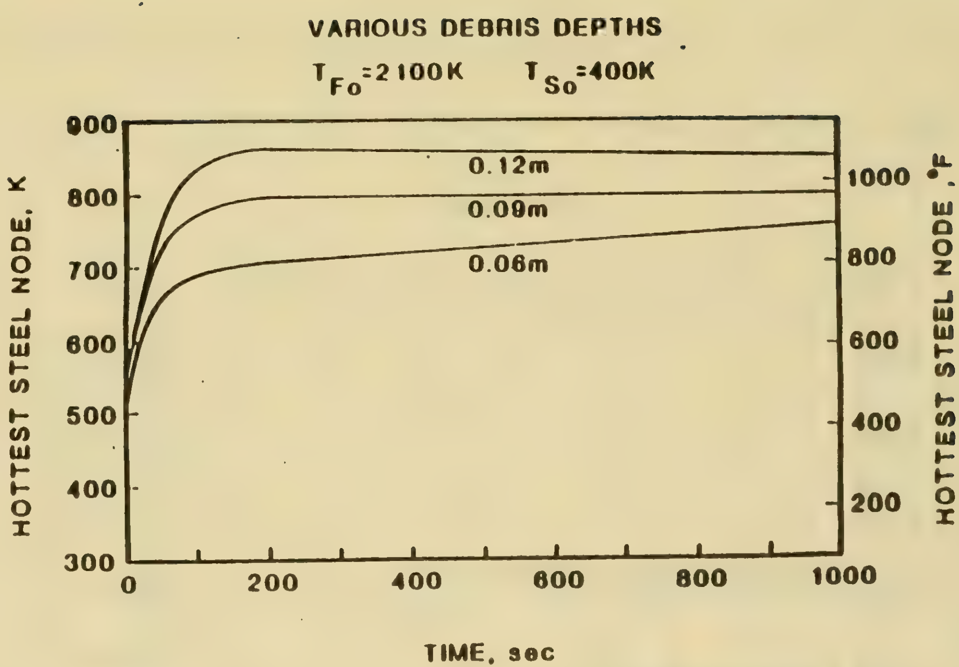

Figure 4 Thermal history of the hottest shell node for various debris depths.

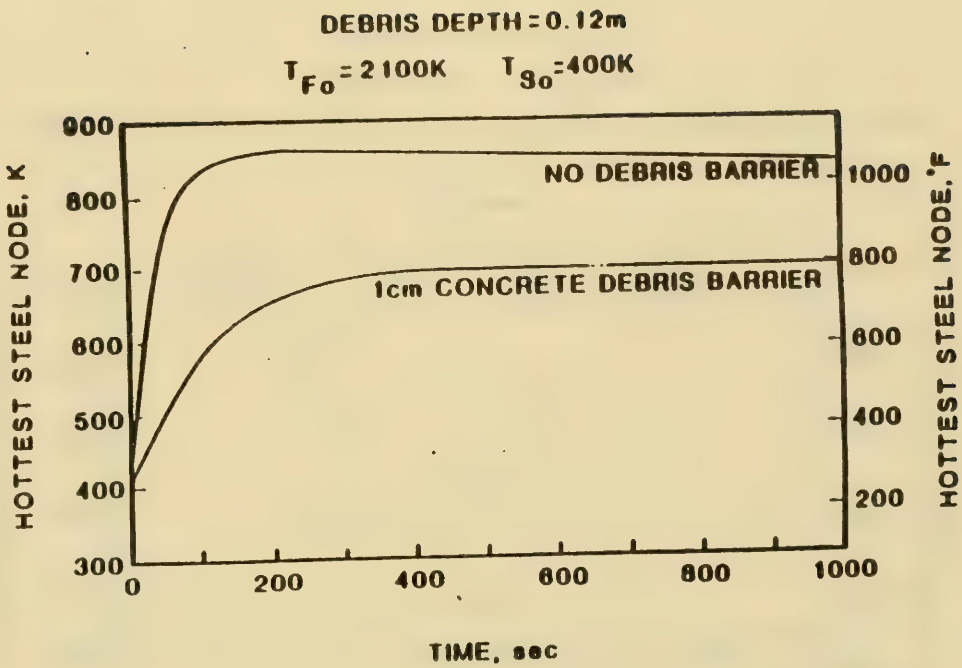

Figure 5 Influence of a 1 cm thick concrete barrier for the hottest node.

The CHAIRMAN. That's 80 or 90 percent of the time, as I understand?

Mr. MURLEY. Again, the understanding that I have, under these very unlikely conditions, is that it could fail, yes.

The CHAIRMAN. We'll put the entire report in the record. I'll read two excerpts. First, "the probability of early containment failure for Mark I [boiling water reactors is] in the 80- or 90-percent range," and second, "containment failure by melt-through is a highly probable mechanism of early containment failure."

What Brookhaven has said is that Mark I reactors are highly likely to rupture, release high amounts of radiation into the environment.

Am I to understand that the NRC is permitting nuclear plants to rely on the Mark I system to continue to operate?

Mr. MURLEY. Yes. As I said, I think I need to say this because people are concerned. The NRC believes that the Mark I plants are operated safely today. We have research programs that are looking for ways to make them safer.

The CHAIRMAN. I don't want——

Mr. MURLEY. I don't want to leave the impression that these plants are like Chernobyl. I think that would be a disservice, because they are not. These containments, we think, will function and do their job in most accidents. It is only the very severe and very unlikely accidents that we are talking about where they could fail early.

The CHAIRMAN. That ought to be reassuring. [Laughter.]

Mr. MURLEY. We are looking for ways that can improve even in those severe accidents.

The CHAIRMAN. I think that the problem that you have is that—here you have a study that is done for your own commission that draws this kind of a conclusion, which I have just read, and then you respond there really isn't a problem. What are people suppose to assume on that? You have a study for your commission which reached one conclusion and then you comment and testify that there is nothing really to worry about.

Mr. MURLEY. I didn't quite say that, sir.

The CHAIRMAN. All right. There is something to worry about?

Mr. MURLEY. In the sense, under very severe accident conditions, these containments could fail, and we are looking at that. We're looking to see what improvements can be made to reduce that failure problem.

The CHAIRMAN. Let's continue.

Mr. MURLEY. Questions have been raised regarding the Mark 1 containment at Pilgrim and the direct torus vent modification being considered by Boston Edison. The direct torus vent would provide a hardened path from the containment torus structure to the plant stack and would be used to relieve containment pressure in certain severe accident condition. During staff review of this modification, a number of questions were asked of Boston Edison regarding the use of the direct torus vent. These questions must be resolved before this system is placed into service.

Regarding the management area, Boston Edison has made a number of changes that we believe are improvements. In early 1987, Mr. Ralph Bird was hired as the senior vice president of Nu-

clear. He has extensive nuclear navy and management experience. Changes have been made in the on-site organization, additional personnel have been hired and programs for improvement are being implemented. The NRC staff has a special programmatic approach for assessing the Boston Edison progress at Pilgrim. Our activities are being coordinated by an assessment panel that is chaired by the senior staff members from Region 1, and includes representative from the region and from NRC headquarters. Once the Pilgrim restart plan has been reviewed by NRC, and after Boston Edison has stated it is ready to restart Pilgrim, this panel then will assess restart readiness. It's assessment will be a comprehensive evaluation that considers the general readiness of the plant and personnel to resume safe operation and will include a comprehensive on-site team inspection.

In addition, as we indicated to you, Senator Kennedy, and to Congressman Studds in Chairman Zech's letters of November 20, 1987, we will conduct several public meetings to insure opportunity for public participation and input to the assessment panel regarding the Boston Edison restart plan. These meetings will be formal, transcribed sessions at which the public's testimony will be heard by NRC senior staff. After the NRC staff has completed the restart readiness assessment, there will be a public meeting at NRC headquarters at which the staff will brief the NRC Commissioners on our findings and recommendation so that the Commission itself can make the ultimate decision.

The CHAIRMAN. That's part of the problem. I mean with all respect to your dedication and service, you hear the testimony; you make the recommendation; then they, the Commissioners, can either take it or not take it. There is no opportunity—perhaps you can reach one kind of conclusion. As I understand the proceeding, there is not much opportunity for those who differ with you, whether they are for or against, to be able to make presentations. The Commissioner can either take or not take your recommendations. And that, I think, is the reason or part of the reason why people want to have an adjudicatory hearing.

Now, as I understand—would you answer this? How many of those section 2.206 petitions for adjudicatory hearings have been filed with the NRC?

Mr. MURLEY. I'll have to provide you the exact number for the record.

The CHAIRMAN. Do you know how many have been granted?

Mr. MURLEY. I don't know that.

The CHAIRMAN. As I understand it, one has been, and only once did the NRC grant a special one as a result of a petition. Do you know any reason why they don't grant any more of these hearings?

Mr. MURLEY. I think it is probably more than one, but we'll get you the correct number for the record. Frequently, the petitions that we receive are asking us to reconsider a licensing action that we've already taken.

The CHAIRMAN. What if it comes before you make a judgment? If we make that petition, will you support that for us?

Mr. MURLEY. I'm sorry——

The CHAIRMAN. If we make that petition for an adjudicatory hearing prior to the time that there is the decision; would you sup-

port that, given the fact that you have been here this evening, and the type of witnesses that we have heard tonight?

Mr. MURLEY. We already responded to that, Senator, and the answer is that we agreed that we should get the views of the public and we think that there are several opportunities. I've mentioned several of them. Adjudicatory hearing rights are triggered really by NRC licensing action, which in this case would be an action against Boston Edison's license, which would be an enforcement matter. Boston Edison would be the one to have the hearing rights.

The CHAIRMAN. As I understand it, it can be granted on a discretionary basis. We can get the standard out, but the law, as I understand it, provides it can also be done on a discretionary basis.

Mr. MURLEY. Yes. There can be hearing rights, adjudicatory hearing rights, granted on a discretionary basis but the Commissioners have done that very infrequently.

The CHAIRMAN. But you will support our petition, Mr. Murley, [laughter] while you're in front of all these nice people here.

Mr. MURLEY. I absolutely support the need to get the views of the public and I have done that myself. I work for the Commissioners and I have to get their approval.

The CHAIRMAN. Let me move on to another subject. As I understand, the hearing petitions filed by the utilities were granted. We find that in terms of the discretionary power of the NRC, when their petitions have come from them there was only one instance—of a denial how do you think people will react to that? What the companies want, they get; and if the people want it, they give it a lot of thoughtful consideration. What is the perception? What do you think people believe when the system is kind of rigged like that? I don't mean to say rigged all the time, but when it is rigged like that?

Mr. MURLEY. I understand your concern and the public's concern. We do have to follow our administrative procedures. We're professionals. We're trying to regulate in an area that is highly controversial.

The CHAIRMAN. Order. We want to give the witness full attention and full courtesy this evening. We still have to get additional testimony and I would ask him to proceed.

Mr. MURLEY. I'll continue with my prepared testimony. If restart is authorized, NRC would increase its inspection coverage for the restart program by round-the-clock coverage in startup on-site activity. A number of hold points would be instituted and Boston Edison would not be permitted to proceed without NRC authorization. These decisions would be based on the on-site inspection team's evaluation of the Pilgrim operation.

In addition of the areas previously discussed, a number of emergency preparedness concerns have been raised at Pilgrim since the Confirmatory Action Letter was issued in April 1986. Mr. Krimm has already testified of the FEMA findings.

On August 18, 1987, the NRC transmitted the FEMA report to Boston Edison and requested that the utility provide us an action plan and a schedule for assisting the Commonwealth of Massachusetts and local governments in addressing the FEMA-identified emergency planning issues. Boston Edison submitted its action plan on September 17, 1987. This action plan details Boston Edi-

son's plans to assist the Commonwealth and local governments as well as describing resources and a schedule for completion.

Over the past few months, Boston Edison, the Commonwealth and the local governments in the Pilgrim area have committed considerable resources and efforts toward resolving these concerns. The current status, as we understand, is as follows: Drafts of local plans were completed November 1, 1987. These currently are in review in the respective towns. Drafts of local procedures are in preparation. These address issues such as buses and sheltering. The draft Massachusetts Civil Defense Authority Area II plan is complete and under review by the Commonwealth. The draft of the Commonwealth plan for Pilgrim is nearing completion. A training program has been developed by Boston Edison and provided to the Massachusetts Civil Defense Authority.

On December 17, 1987, the NRC received the report on Emergency Preparedness for an Accident at Pilgrim Nuclear Power Plant from the Commonwealth. NRC and FEMA will consider this report in their ongoing review. Additionally, Boston Edison submitted an exemption request to NRC on the requirement for conducting its biennial full participation exercise. The request was based on the need to make improvements in emergency plans. NRC approved that exemption request, stipulating that the exercise be conducted no later than June 30, 1988.

The NRC agrees that emergency planning deficiencies do exist at Pilgrim and further agrees that corrective actions are needed. However, considering the shutdown status of the plant and the progress that is being made to address emergency planning issues, we have not needed to take enforcement action regarding emergency planning.

The NRC will not permit the facility to resume operation until corrective actions satisfactory to NRC have been taken to address the emergency planning deficiencies identified by FEMA. We will give special attention to the improved evacuation plans for school and day care centers, as well as improved evacuation plans for special needs and transportation-dependent population in the 10-mile emergency planning zone. We will require some demonstration of the critical aspects of these evacuation plans before we can decide if Pilgrim is ready to resume operation.

However, it may be that restart can be authorized with some emergency planning issues not fully resolved. Under the NRC framework, whether an outstanding emergency planning deficiency must delay restart will depend upon considerations of the gravity of the deficiency, the nature of any compensatory action and progress toward correction of the deficiency. For Pilgrim, this decision will be made ultimately by the commission itself.

In conclusion, there has been and will continue to be a high level of NRC management attention to Pilgrim. The NRC staff has adopted a unique approach for monitoring the performance of the utility as it implements needed improvement. This approach includes opportunities for public input to the process. I want to assure the committee that Pilgrim will not be permitted to restart until the NRC staff has reviewed carefully the plant improvements, the management improvements and the offsite emergency

preparedness improvements and has concluded that the plant will be operated safely.

Thank you, Senator. That concludes my testimony.

[The prepared statement of Mr. Murley follows:]

TESTIMONY BEFORE THE SENATE

LABOR AND HUMAN RESOURCES COMMITTEE

REGARDING THE PILGRIM NUCLEAR POWER STATION

DR. THOMAS MURLEY, DIRECTOR

OFFICE OF NUCLEAR REACTOR REGULATION

U. S. NUCLEAR REGULATORY COMMISSION

PLYMOUTH, MASSACHUSETTS

JANUARY 7, 1988

Thank you, Mr. Chairman. In response to the request of the Committee, I am here to discuss the status of the issues concerning the restart of the Pilgrim Nuclear Power Station. With me today is Mr. William Russell, who is the Regional Administrator of NRC's Region I office.

As part of its regulatory process, the NRC performs a Systematic Assessment of Licensee Performance (SALP). In early 1986 the NRC staff issued a SALP report on Pilgrim covering a 12-month period from October 1984 to October 1985. That report brought into focus a number of problem areas at Pilgrim such as a shortage of licensed operators; a large maintenance backlog with a number of management vacancies in the maintenance area; radiological protection program weaknesses; emergency preparedness program weaknesses; and instances of poor procedural adherence and administrative practices at the plant. These problems were compounded by a lack of critical self-assessment on the part of Boston Edison and a tendency toward superficial corrective actions. We met with the senior management of Boston Edison in January 1986 and forcefully told them of our concerns. In February 1986, a special team of inspectors was sent to the plant for several weeks of around-the-clock inspection. We did this to obtain a more complete understanding of the underlying reasons for the poor performance. This team confirmed the SALP conclusions.

On April 12, 1986, a series of plant hardware problems caused the plant to shut down. At that time, I issued a Confirmatory Action Letter documenting Boston Edison's intent to keep the plant shut down. Later in the summer of 1986, I revised and extended the Confirmatory Action Letter to confirm that Boston Edison would keep Pilgrim shut down until resolution of those management deficiencies identified in the SALP report and by the special team inspections.

Our most recent SALP review covered the period from November 1985 to January 1987, and was issued April 8, 1987. This report identified five areas that exhibited recurring program weaknesses. These are:

- radiological controls
- surveillance of safety related equipment
- fire protection
- physical security and safeguards
- assurance of quality

Over the past few years the NRC has devoted considerable resources to monitor the Boston Edison efforts to address these weaknesses. For example, the NRC has three full-time resident inspectors at Pilgrim, whereas most single-unit facilities have two residents. Furthermore, we have supplemented these resident inspectors with an extensive region-based inspection effort and have committed additional headquarters resources to review and evaluate Pilgrim issues. This includes a dedicated assessment panel composed of NRC managers to overview and consolidate the NRC approach to Pilgrim activities.

Let me summarize the current status of major Boston Edison and NRC activities regarding the Pilgrim facility. The facility remains shut down. The NRC has met frequently with Boston Edison, members of the public, and with the Commonwealth of Massachusetts, as well as with local officials to discuss issues regarding Pilgrim. Boston Edison has developed a restart plan that describes the programs, plans, and actions considered necessary by the company to restart and safely operate Pilgrim. Although Boston Edison has not reached a position where it would request that NRC consider a restart decision, the utility has completed a number of plant improvements. The reactor was refueled in October and several major systems tests on the reactor coolant system and containment structure have been completed.

As part of its Safety Enhancement Program (SEP), Boston Edison has proposed a number of modifications intended to improve plant performance in the event of an accident at Pilgrim. The NRC staff reviewed these modifications in August 1987 and concluded that eight of the modifications were appropriate for implementation. These include containment spray nozzle modifications, the installation of a third emergency diesel generator, modifications to fire protection systems, and features to respond to an anticipated transient without scram. The SEP modifications are designed to mitigate the effects of abnormal conditions that could develop in containment in the event of an unlikely accident. These modifications are in consonance with NRC goals to enhance containment performance under severe accident conditions. We have not made them formal requirements for restart of Pilgrim. We are, however, ensuring that these modifications do not result in lessened safety for the plant.

Questions have been raised regarding the Mark I containment at Pilgrim and the Direct Torus Vent modification being considered by Boston Edison. The Direct Torus Vent would provide a hardened path from the containment torus structure to the plant stack and would be used to relieve containment pressure in certain severe accident situations. During staff review of this proposed modification a number of questions were asked of Boston Edison regarding the use of the Direct Torus Vent. These questions must be resolved before this system is placed into service.

Regarding the management area, Boston Edison has made a number of changes that we believe are improvements. In early 1987 Mr. Ralph Bird was hired as the

Senior Vice President - Nuclear. He has extensive nuclear navy and management experience. Changes have been made in the onsite organization, additional personnel have been hired and programs for improvement are being implemented. The NRC staff will assess the effectiveness of these programs and management changes in the coming months.

The NRC has a special programmatic approach for assessing the Boston Edison progress at Pilgrim. Our activities are being coordinated by an Assessment Panel that is chaired by a senior staff member from Region I and includes representatives from the region and headquarters. Once the Pilgrim restart plan has been reviewed by NRC and after Boston Edison has stated it is ready to restart Pilgrim, this Panel will assess restart readiness. This assessment will be a comprehensive evaluation that considers the general readiness of the plant and personnel to resume safe operation and will include a comprehensive onsite team inspection.

In addition, as we indicated to Senator Kennedy and Congressman Studds in Chairman Zech's letters of November 20, 1987, we will conduct several public meetings to ensure opportunity for public participation and input to the Assessment Panel regarding the Boston Edison restart plan. These meetings will be formal, transcribed sessions at which the public's testimony will be heard by NRC senior staff. After the NRC staff has completed the restart readiness assessment, there will be a public meeting at NRC headquarters at which the staff will brief the NRC Commissioners on our findings and recommendations so that the Commission itself can make the ultimate restart decision.

If restart is authorized, NRC would increase its inspection coverage for the startup program to provide around-the-clock coverage of startup and site activities. A number of "hold-points" will be instituted and Boston Edison would not be permitted to proceed without NRC authorization. These decisions would be based on the on-site inspection team's evaluation of Pilgrim operation.

In addition to the areas previously discussed, a number of emergency preparedness concerns have been raised at Pilgrim since the Confirmatory Action Letter was issued in April 1986. On July 15, 1986, State Senator William B. Golden and others filed a Petition with the NRC, requesting that NRC order Boston Edison to show cause why Pilgrim should not remain closed or have its operating license suspended. That request was based, in part, on emergency preparedness concerns. On December 22, 1986, the Secretary of Public Safety of the Commonwealth of Massachusetts sent FEMA a copy of an Office of Public Safety report entitled, "Report to the Governor on Emergency Preparedness for an Accident at the Pilgrim Nuclear Power Station," dated December 1986. In a memorandum to NRC dated March 31, 1987, FEMA stated that it was also conducting a self-initiated review of the overall state of emergency preparedness at Pilgrim Station. FEMA subsequently committed to prepare, on a priority basis, a consolidated evaluation that would address the Petition issues, the report submitted by the Office of Public Safety, its self-initiated review, and other relevant available information.

On August 6, 1987, FEMA sent its report to NRC. It is entitled, "Self-Initiated

Review and Interim Finding for the Pilgrim Nuclear Power Station, Plymouth, Massachusetts." In this report, FEMA listed the following six areas of concern in the Commonwealth of Massachusetts emergency plans for the ten-mile emergency planning zone surrounding Pilgrim:

1. Lack of evacuation plans for public and private schools and day care centers.
2. Lack of a reception center for people evacuating to the north.
3. Lack of identifiable public shelters for the beach population.
4. Inadequate planning for the evacuation of the special needs population.
5. Inadequate planning for the evacuation of the transportation-dependent population.
6. Overall lack of progress in planning and apparent diminution in emergency preparedness.

On August 18, 1987, the NRC transmitted the FEMA report to Boston Edison and requested that the utility provide an action plan and schedule for assisting the Commonwealth of Massachusetts and local governments in addressing the FEMA identified emergency planning issues. Boston Edison submitted its Action Plan on September 17, 1987. This action plan details Boston Edison's plans to assist the Commonwealth of Massachusetts and local governments, as well as describing resources and a schedule for completion.

Over the past few months, Boston Edison, the Commonwealth, and the local

governments in the Pilgrim area have committed considerable resources and effort toward resolving these concerns. Current status is as follows:

- Drafts of local plans were complete November 1, 1987. These currently are in review in the respective towns.

- Drafts of local procedures are in preparation. These address issues such as buses and sheltering.

- The Draft Massachusetts Civil Defense Authority Area II Plan is complete and under review by the Commonwealth.

- The draft of the Commonwealth Plan for Pilgrim is nearing completion.

- A training program has been developed by Boston Edison and provided to the Massachusetts Civil Defense Authority.

- On December 17, 1987 the NRC received the "Report on Emergency Preparedness for an Accident at Pilgrim Nuclear Power Station," from the Commonwealth of Massachusetts. NRC and FEMA will consider this report in their ongoing reviews.

Additionally, Boston Edison submitted an exemption request to NRC on the requirements for conducting its Biennial Full Participation Exercise. The request was based on the need to make improvements in emergency plans. NRC approved that exemption request, stipulating that the exercise be conducted no later than June 30, 1988.

The NRC agrees that emergency planning deficiencies do exist at Pilgrim and further agrees that corrective actions are needed. However, considering the shutdown status of the plant and the progress that is being made to address emergency planning issues, we have not needed to take enforcement action regarding emergency planning.

The NRC will not permit the facility to resume operation until corrective actions satisfactory to NRC have been taken to address the emergency planning deficiencies identified by FEMA. We will give special attention to the improved evacuation plans for schools and day care centers as well as the improved evacuation plans for special-needs and transportation-dependent populations in the ten-mile emergency planning zone. We will require some demonstration of the critical aspects of these evacuation plans before we can decide that Pilgrim is ready to resume operation.

However, it may be that restart can be authorized with some emergency planning issues not fully resolved. Under the NRC's regulatory framework, whether an outstanding emergency planning deficiency must delay restart will depend upon considerations of the gravity of the deficiency, the nature of any compensatory actions, and progress toward correction of the deficiency. For Pilgrim this decision will be made ultimately by the Commission itself.

In conclusion, there has been and will continue to be a high level of NRC management attention to Pilgrim. The NRC staff has adopted a unique approach for monitoring the performance of the utility as it implements needed improvements. This approach includes opportunities for public input to the process. I want to assure the Committee that Pilgrim will not be permitted to restart until the NRC staff has reviewed carefully the plant improvements, the management improvements, and the offsite emergency preparedness improvements and has concluded that the plant will be operated safely.

This concludes my testimony. Mr. Russell and I would be glad to answer questions.

The CHAIRMAN. Do you know what I think is almost as much of a problem as some of the technical issues, some of which we have gone over—we'll have time to go over some more—but there is a problem, I think, in the tone of your testimony, which seems to run throughout the statement, seems to lean towards restart. It leaves the impression that the issues have already been decided, almost as if the NRC has already decided that the burden is on those who believe Pilgrim should not be allowed to restart. It seems to me to lean toward restart. Leaves the impression that the issues have already been decided. Isn't that backwards?

Mr. MURLEY. I am the one who decided in April of 1986, that the plant ought to stay shut down. I'm the one who told them that there are some additional things that need to be corrected and NRC is keeping it shut down. There is not a presumption that the plant can restart. They have to convince us that they have made these corrections.

The CHAIRMAN. At the bottom of page 8 of your statement, you start off, "However, it may be that restart can be authorized with some emergency planning issues not fully resolved."

Now, that's really reassuring, I would expect, to a lot of people.

Mr. MURLEY. May I explain that?

The CHAIRMAN. Sure. Why can't they just maintain that they can't restart until the State of Massachusetts is satisfied that they have in place a more effective emergency plan.

Mr. MURLEY. I don't mean that to be a pugnacious statement, but I have to explain that emergency preparedness is a changing process. Mr. Krimm mentioned earlier that things change around the site: population changes, new schools come in. That's why we require regular exercise of these plans. It is not uncommon to find deficiencies in emergency plans and we don't generally require that a plant be shut down while these deficiencies are corrected. The defense in-depth philosophy has guided the nuclear regulation over the years, which is an area that relies on several levels of protection. Therefore, we don't necessarily have to shut plants down while deficiencies are corrected. Nonetheless, with Pilgrim, we agreed that these deficiencies are quite serious and that they must take corrective action before we allow them to restart.

The CHAIRMAN. Wouldn't you agree with me, Dr. Murley, that there is a considerable question in the minds of many when problems which you identified, which you have gone through on the first page of your testimony and we reviewed briefly during the course of your oral presentation, that they would have some serious problems in knowing whether they were resolved unless—without your performing another SALP prior to restart? Don't you believe that the NRC should conduct another SALP?

Mr. MURLEY. We are going to do a comprehensive evaluation, including an around-the-clock inspection. I'll let Mr. Russell, who's responsible for the SALP Report to respond to that.

Mr. RUSSELL. Senator Kennedy, I would like to add two points to the record as it relates to evaluation by the staff of the items which are identified.

First, during the public hearing that we proposed to hold, the first one was to gather concerns. We agreed to come back and hold

a second meeting to identify the resolution of those concerns, at least to the staff's standards of what is required.

We have also indicated that we will conduct a detailed team inspection to address both the management issues and whether the program can be put into place effectively. We have indicated to the State of Massachusetts that they may have an observer to observe that inspection as it is conducted by the NRC, such that they would be in a position to see how that process is conducted.

We will also have self assessment performed by the utility themselves, which would be the equivalent of the utility SALP report and the staff will be there to evaluate their performance. The purpose is to compare the two results and see if the utility is able to critically evaluate their own performance. Those are the——

The CHAIRMAN. How will that differ from a SALP report?

Mr. RUSSELL. A SALP report, if I can call it, Mini-SALP. This has been done for two facilities recently in Region 1 for Beaver Valley Unit 2 during their startup program and for a Nine Mile Point unit 2 from the power ascension to actually evaluate the performance of the company in critical——

The CHAIRMAN. I hear your words. I was just trying to understand how a Mini-SALP is different from a full SALP?

Mr. RUSSELL. The difference is that we specify particular areas to be evaluated of concerns that are associated with operation.

The CHAIRMAN. Do they cover the other areas as well? Do they have special emphasis in the areas of radiological monitoring or the other areas that you identified for weaknesses?

Mr. RUSSELL. We will specifically address each of the areas of the five areas that have been identified as being marginal performance; radiological monitoring, security surveillance. Those areas I indicated each will be addressed in detail.

The CHAIRMAN. And the other parts that are included in the evaluation in the SALP report will also be included?

Mr. RUSSELL. Yes, sir. We will reach a conclusion. The format will be somewhat different. I will be issuing a readiness for operation report that will go to the Dr. Murley as a part of the deliberations. That will be a process——

The CHAIRMAN. Excuse me for interrupting, but the hour is late. As I understand what you say when I asked about whether you would have a SALP report, you say there are many SALPs. You'll look at and evaluate the critical areas which have been identified as trouble areas and get a full report on that, and then the other areas which you would normally do in a SALP report will also be covered. Is that your——

Mr. RUSSELL. That is correct. They are in different documents. The SALP report is——

The CHAIRMAN. But even if they are in different documents, they are collected at the same time. Would there be one particular place that someone can——

Mr. MURLEY. There is no doubt that we'll have a written report of all those deficiencies that we found and the circumstances.

The CHAIRMAN. That will be done before there is obvious——

Mr. MURLEY. Yes. Absolutely.

The CHAIRMAN. There is no way of knowing exactly when this is going to be ready; is that correct?

Mr. MURLEY. No. It will be well before any recommendation is made.

The CHAIRMAN. I suppose this is important, obviously, in terms of your own review. It is important as well that people have at least a reasonable chance to review it and to get some recommendation or reaction. Can you give us any assurances about that?

Mr. MURLEY. I don't know that we have talked about that. I think it is a good idea, so I will commit that we will do it.

The CHAIRMAN. You will commit to reviewing it——

Mr. MURLEY. Yes.

The CHAIRMAN [continuing]. In a reasonable time?

Mr. MURLEY. Yes.

Mr. RUSSELL. Senator Kennedy, I have committed to coming back to this area to review those results following the team inspections.

The CHAIRMAN. It would be marvelous to get our commissioners, once—well, let us try and work on that.

I may have other questions which I would like to submit to you both. I will make those a part of the record. I will welcome your responses. I want to thank you very much for coming up here. I will excuse you.

[Additional material supplied for the record follows:]

EDWARD M. KENNEDY
MASSACHUSETTS

United States Senate
WASHINGTON, DC 20510

March 8, 1988

Dr. Thomas E. Murley
Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop 12-G-18
Washington, D.C. 20555

Dear Dr. Murley:

First, I want to express to you my appreciation for your participation in the Senate Labor and Human Resources Committee hearing on the proposed restart of the Pilgrim Nuclear Power Station in Plymouth, Massachusetts.

Since the hearing ran later than expected, there were a number of questions which I did not have an opportunity to ask you. At this time, I would like to request that you respond to the attached list of questions. Your answers will be included in the hearing record.

Again, I appreciate your assistance and look forward to your timely response.

Sincerely,

Edward M. Kennedy

enclosure

1. There remains a great deal of uncertainty as to how the NRC will evaluate whether the Pilgrim reactor is ready for restart. As you know, I fully support the adjudicatory hearing process and hope that the NRC will agree that an adjudicatory hearing is the proper way to proceed. I am aware that there has been one public meeting in Plymouth and that another meeting is contemplated. Would you provide me with a schedule of planned or proposed future meetings, including the location of the meetings, who will attend from the NRC, and what public involvement there will be at the meetings. I am also interested in learning if a final decision has been made on Governor Dukakis' and Attorney General Shannon's petition for an adjudicatory hearing. If a decision has not yet been made, when will it be made?

2. During your testimony, you mentioned that the NRC had asked Boston Edison a series of questions relating to direct torus venting. Specifically, Edison was asked when and under what conditions they would utilize a direct torus vent. At the time of the hearing, Boston Edison had not yet responded to the NRC's questions. You indicated that a response would be necessary before the NRC could proceed with considering whether the installation of a direct torus vent was warranted at Pilgrim. Has Edison responded to the NRC's questions? If so, has the NRC made a decision on whether it will permit the licensee to make the direct torus vent improvement?

3. During the hearing, I asked you how many times the NRC has been formally requested to hold an adjudicatory hearing in relation to restarting or licensing a nuclear reactor. I would be interested in learning who made the requests (i.e., whether they came from the licensee, from a State government, or elsewhere), and whether the NRC acted favorably or unfavorably on the requests (and/or petitions)?

4. You may be aware that the Massachusetts State Legislature is considering a bill which would expand the Emergency Planning Zone around nuclear power plants in Massachusetts to 50 miles. Would the NRC support this initiative?

5. In your prepared statement you said, "The NRC will not permit the facility (Pilgrim) to resume operation until corrective actions satisfactory to the NRC have been taken to address the Emergency Planning deficiencies identified by FEMA". Have those corrective actions been taken? You also indicated that the NRC would allow the plant to restart without the resolution of all Emergency Planning deficiencies. What deficiencies would the NRC allow to be left unresolved at restart?

6. You said in your testimony that a detailed team inspection will be performed at Pilgrim prior to a restart decision. Has that inspection commenced? When will it conclude? How long will the public have to review the NRC's findings relative to the inspection and prior to a restart decision?

7. A great deal of public concern has focused on a release of radioactive resin which occurred at Pilgrim in the summer of 1982. It is my understanding that radioactive resin was found on the rooftops of buildings owned by Boston Edison. Would you please provide all the data the NRC has on file (including on-site and off-site readings, dosimeter readings and stack readings) indicating what the level of radioactivity had been in the period of time when the resin was released.

8. In recent years, Boston Edison has had unsatisfactory ratings in the area of fire protection. I would like to know if Pilgrim is now in full compliance with fire protection requirements? Are all barriers, fire doors and penetration seals repaired and capable of passing required testing? Are fire watches still required in certain areas of the plant? How many fire watches are still needed? Will the NRC require Edison to complete the upgrading of the entire fire protection system prior to allowing restart? How many maintenance requests are still outstanding in the area of fire protection? Please also comment on the condition of the halon system in the computer room at the plant and the smoke detectors over the spent fuel pool.

9. How many automatic and manual scrams have occurred at Pilgrim since the plant became operational? What is the annual industry-wide average?

10. How many "unusual events" and how many "alerts" have been declared at Pilgrim since 1972? Please describe and give the date of each report. How does this compare to the industry-wide average?

11. How many violations of NRC regulations have occurred at Pilgrim since it began operation? What is the industry-wide average?

12. There have been a number of allegations concerning the illegal dumping of radioactive waste on Boston Edison property. Concerns have also been raised over Edison's use of the town dump for disposal of radioactive material. Would you please describe what monitoring the NRC conducts or requires on materials and waste leaving the Pilgrim site. Has the NRC or the licensee performed tests on Edison property and at the town dump to ensure that there are no elevated levels of radiation at areas suspected of containing radioactive waste? Where and when were tests conducted? What were the results?

13. Has Pilgrim ever violated established radiation emission levels i.e., have there been any releases from the plant which exceeded standards set by the NRC?

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C 20555

April 29, 1988

The Honorable Edward M. Kennedy
United States Senate
Washington, D. C. 20510

Dear Senator Kennedy:

Enclosed are responses to questions forwarded with your March 8, 1988 letter to Thomas E. Murley, who testified for the Nuclear Regulatory Commission at the Senate Labor and Human Resources Committee hearing on the proposed restart of the Pilgrim plant.

A copy of these responses has been sent to Boston Edison Company, the licensee for Pilgrim, for verification of the accuracy and completeness of certain information. We expect their comments within two weeks. If any corrections or additions to the enclosed responses are necessary as a result of the licensee's review, we will provide you a revised version of our submittal.

Sincerely,

John C. Bradburne
Congressional Affairs Director
Office of Governmental and Public Affairs

Enclosure:
As stated

QUESTION 1. There remains a great deal of uncertainty as to how the NRC will evaluate whether the Pilgrim reactor is ready to restart. As you know, I fully support the adjudicatory hearing process and hope that the NRC will agree that an adjudicatory hearing is the proper way to proceed. I am aware that there has been one public meeting in Plymouth and that another meeting is contemplated. Would you provide me with a schedule of planned or proposed future meetings, including the location of the meetings, who will attend from the NRC, and what public involvement there will be at the meetings. I am also interested in learning if a final decision has been made on Governor Dukakis' and Attorney General Shannon's petition for an adjudicatory hearing. If a decision has not yet been made, when will it be made?

ANSWER.

The NRC staff and local officials in Massachusetts have engaged in a continuing dialogue on the Pilgrim situation. This dialogue has included public meetings with the Plymouth Board of Selectmen and Chamber of Commerce, the Duxbury Board of Selectmen, the Massachusetts Joint Committee on Energy, the Massachusetts Legislative Committee on the Investigation and Study of the Pilgrim Station, the Town of Plymouth Advisory Committee on Nuclear Matters, and others. The NRC staff also participated in a public forum on the Pilgrim situation at the

Duxbury High School on October 29, 1987. This meeting was sponsored by the Duxbury Board of Selectmen. Representatives from some of these groups also have participated in NRC Region I management meetings dealing with the Pilgrim facility, including the Systematic Assessment of Licensee Performance (SALP) meeting held on May 7, 1987. On October 8, 1987, the NRC met with representatives of the Commonwealth of Massachusetts in our Region I office. This meeting, which was open to the public, was held to discuss agenda items proposed by the Commonwealth, including emergency preparedness issues, the status of various NRC technical reviews, and inspection activities expected in the next few months. Subsequently, other meetings have been held with representatives of the Commonwealth discussing the same topics.

The most recent meeting, which was coordinated with the Commonwealth and was open to participation by interested members of the public, was held in Plymouth on February 18, 1988. The purpose of this meeting was to receive comments on the Pilgrim Nuclear Station Restart Plan.

The following is the projected schedule, location, and expected participation for future meetings which are currently planned. The schedules are subject to change depending on several of the integrated activities being conducted by both the licensee and NRC staff.

1. Public meeting(s) will be held in the Plymouth area, currently projected for late April or early May, to discuss the disposition of comments and

QUESTION 1. (Continued) 3

concerns raised in the February 18, 1988 public meeting. The meeting(s) will be chaired by NRC senior staff members and members of the public will will be invited to participate.

2. A Commission meeting, currently projected for June 1988, will be conducted to brief the Commission on the status of licensee activities relating to plant restart and the NRC staff's plans and schedule for completing their readiness review. This will be a public meeting held in the Washington, D.C. area.

3. A meeting will be conducted by the NRC staff in the Plymouth area to discuss with interested members of the public the results of NRC's team inspection of the readiness of the plant, and licensee management preparations to support the restart and safe operation of the plant. This meeting is tentatively scheduled for July or August 1988.

4. A meeting, currently projected for July or August 1988, will be held in the Plymouth area with State Senator William Golden and the other petitioners who submitted the July 1986 Petition, under 10 CFR Part 2.206, if the petitioners desire a meeting. Senior NRC staff members will discuss emergency preparedness, management, and plant readiness issues with the Petitions and answer any questions they may have. Members of the public will be invited to participate. This meeting may be coordinated with the meeting addressed in number 3 above.

QUESTION 1. (Continued) 4

5. The Commission will hold an additional public meeting at NRC Headquarters prior to making any decisions regarding the readiness of Pilgrim to resume operations. The licensee will provide a full accounting of its readiness to restart the Pilgrim station during this meeting. The staff will also brief the Commission on the results of its independent inspection and review of licensee activities.

Other public meetings, including those with Boston Edison, will be held as circumstances warrant. These meetings will be announced pursuant to NRC staff policy on open meetings (43 FR 28058 which is enclosed).

A final decision has not been made on Governor Dukakis' and Attorney General Shannon's petition for an adjudicatory hearing. The petitioners were notified by letter dated November 13, 1987 that the Petition would be treated as a request for action under 10 CFR Part 2.206 of the Commission's regulations. The staff is nearing completion of its evaluation of the petition, and expects to render a decision in the near future. We will advise you as soon as we make a decision on the petition.

Enclosure:
43 FR 28058

Enclosure to Question 1

UNITED STATES NUCLEAR REGULATORY COMMISSION

RULES and REGULATIONS

TITLE 10, CHAPTER 1, CODE OF FEDERAL REGULATIONS—ENERGY

COMMISSION NOTICES

POLICY STATEMENTS

Conduct of Proceedings

43 FR 28058
Published 6/28/78

DOMESTIC LICENSE APPLICATIONS

Open Meetings and Statement of NRC Staff Policy

The Nuclear Regulatory Commission's (NRC's) regulations in 10 CFR 2.102 permit applicants to confer informally with the NRC technical staff during reviews of domestic license or permit applications. These meetings have served as an essential means for the exchange of technical information and views necessary for the technical review of applications. For several years other parties or potential parties to domestic licensing proceedings, as well as members of the general public, have, upon request, been permitted to attend applicant-NRC technical staff meetings as observers. However, the Commission's regulations do not require that others be permitted to attend such informal meetings between applicant and staff, and the general practice being followed in this regard has never been formally articulated. This statement is intended to provide such articulation. It is also noted that this matter is related to the provision for increased public participation which was approved by the Commission during its consideration of NUREG 0292 (Denton Report).

As a general matter, the Commission and staff try to involve concerned citizens in any Commission activity in which they have expressed an interest. All meetings conducted by the NRC technical staff as part of its review of a particular domestic license or permit application (including an application for an amendment to a license or permit) will be open to attendance by all parties or petitioners for leave to intervene in the case. These meetings are intended by the NRC technical staff to facilitate an exchange of information between the applicant and the staff. It is expected that the NRC technical staff and the applicant will actively participate in the meeting. Others may attend as observers. Likewise, when meetings are scheduled between the staff and other parties or petitioners, applicants would be permitted to attend only as observers.

The general policy of open meetings described above will admit of only a few exceptions, which must be approved by the Director of the relevant division. For example, some persons may not be permitted to attend meetings where classified or proprietary information (including sensitive safeguards information) is to be discussed. The NRC staff will prepare a written summary of the unclassified and nonproprietary portions of such meetings and forward the summary to interested persons unable to attend so that they will be informed of what transpired at the meeting. However, attendance will not be limited solely because preliminary opinions, recommendations, or advice will be offered on the merits of the applications during the meeting.

When a party or petitioner for leave to intervene requests, reasonable efforts will be made by the NRC staff to inform the party or petitioner of forthcoming meetings conducted by the NRC technical staff so that appropriate arrangements for attendance can be made. It is recognized that in some cases the need for a prompt meeting may make it impossible or impracticable to notify all parties and petitioners. The policy described above also cannot practicably be applied to chance encounters between NRC technical staff personnel and other parties or petitioners but such chance encounters will not be permitted to serve as a source of information for the conduct of licensing reviews.

46 FR 28533
Published 5/27/81

Statement of Policy on Conduct of Licensing Proceedings

I. Background

The Commission has reviewed the docket of the Atomic Safety and Licensing Board Panel (ASLBP) and the current status of proceedings before its individual boards. In a series of public meetings, the Commission has examined at length all major elements in its licensing procedure. It is clear that a number of difficult problems face the agency as it endeavors to meet its responsibilities in the licensing area. This is especially the case with regard to staff reviews and hearings, where requested, for applications for nuclear power plant operating licenses.

Historically, NRC operating licensing reviews have been completed and the license issued by the time the nuclear plant is ready to operate. Now, for the first time the hearings on a number of operating license applications may not be concluded before construction is completed. This situation is a consequence of the Three Mile Island (TMI) accident, which required a reexamination of the entire regulatory structure. After TMI, for over a year and a half, the Commission's attention and resources were focused on plants which were already licensed to operate and on the preparation of an action plan which specified changes necessary for reactors as a result of the accident.

Although staff review of pending license applications was delayed during this period, utilities which had received construction permits continued to build the authorized plants. The staff is now expediting its review of the applications and an unprecedented number of hearings are scheduled in the next 24 months. Many of these proceedings concern applications for operating licenses. If these proceedings are not concluded prior to the completion of construction, the cost of such delay could reach billions of dollars. The Commission will seek to avoid or reduce such delays whenever measures are available that do not compromise the Commission's fundamental commitment to a fair and thorough hearing process.

Therefore, the Commission is issuing this policy statement on the need for the balanced and efficient conduct of all phases of the hearing process. The Commission appreciates the many difficulties faced by its boards in conducting these contentious and complex proceedings. By and large, the boards have performed very well. This document is intended to deal with problems not primarily of the boards' own making. However, the boards will play an important role in resolving such difficulties.

Individual adjudicatory boards are encouraged to expedite the hearing process by using those management methods already contained in Part 2 of the Commission's Rules and Regulations. The Commission wishes to emphasize though that, in expediting the hearings, the board should ensure that the hearings are fair, and produce a record which leads to high quality decisions that adequately protect the public health and safety and the environment.

Virtually all of the procedural devices discussed in this Statement are currently being employed by sitting boards to varying degrees. The Commission's reemphasis of the use of such tools is intended to reduce the time for completing licensing proceedings. The guidelines set forth below are not to be

QUESTION 2. During your testimony, you mentioned that the NRC had asked Boston Edison a series of questions relating to direct torus venting. Specifically, Edison was asked when and under what conditions they would utilize a direct torus vent. At the time of the hearing, Boston Edison had not yet responded to the NRC's questions. You indicated that a response would be necessary before the NRC could proceed with considering whether the installation of a direct torus vent was warranted at Pilgrim. Has Edison responded to the NRC's questions? If so, has the NRC made a decision on whether it will permit the licensee to make the direct torus vent improvement?

ANSWER.

The Boston Edison Company (BECo) has not yet responded to the questions we posed on August 21, 1987 concerning BECo's submittal of a design for a direct torus vent (DTV). As stated in the testimony, the questions must be resolved before the system is placed into service. The DTV, a hard pipe designed to be capable of providing a path that could withstand high pressures from the containment torus structure to the plant stack, has been installed but with a physical block (blank flanges) to prevent flow and isolate it from the low pressure path. The piping, supports, and blank flange were installed by BECo pursuant to provisions of 10 CFR Part 50.59.

QUESTION 2. (Continued) 2

10 CFR Part 50.59 allows licensees to make changes to their facility as described in the safety analysis report without prior Commission approval, if the proposed change does not involve a change in the technical specifications incorporated in the license or an unreviewed safety question.

An inspection team was sent to the Pilgrim site during the first week of March to review the blanked off vent line. The objective of the inspection was to verify the adequacy of the plant modification and associated licensee safety evaluations. Although the vent line is not operational, we chose to confirm that the plant modification (including the installation of the piping, supports and blank flange) does not adversely affect the function of the other plant systems, structures or the plant response under accident conditions. The inspection team concluded that the plant modification was adequately evaluated by the licensee and the design change had been made with no adverse impact on plant safety. The conclusion was based on a system walkdown, inspection of the supporting documentation, and interviews with utility personnel. At this time the NRC has not made a decision on allowing the completion of the installation or operation of a direct torus vent system.

QUESTION 3. During the hearing, I asked you how many times the NRC has been formally requested to hold adjudicatory hearings in relation to restarting or licensing a nuclear reactor. I would be interested in learning who made the requests (i.e., whether they came from the licensee, from a State government, or elsewhere), and whether the NRC acted favorably or unfavorably on the requests (and/or petitions)?

ANSWER.

There have been contested operating licensing proceedings for most operating nuclear power plants. Our log shows some 80 proceedings. There have also been some 70 proceedings involving amendments to power plants' operating licenses. Many amendment proceedings could affect continued reactor operation.

We have identified 6 proceedings directly involving power plant restarts:

Browns Ferry - 1975; Changes involving startup after fire; Intervenor B. Garner. Commission authorized operation.

Humboldt Bay - 1977; Request to delete seismic upgrade requirements allowing startup of the facility; Intervenor Sierra Club, Friends of the Earth. Proceedings terminated after licensee notified NRC of intent to decommission the facility.

QUESTION 3. (Continued) 2

Trojan - 1978; Proceedings on Commission Order requiring modifications to Control Building; Intervenors D. McCoy, C.Parson, N.Bell, E.Rosolie, S.Willingham, Coalition for Safe Power, Columbia Environmental Council, Bonneville Power Authority, State of Oregon. Commission authorized operation.

Rancho Seco - 1979; Proceeding to permit operation after post-TMI shutdown Order; Licensee requested hearing; Intervenor California Energy Commission et.al. Commission authorized operation.

Three Mile Island 1 - 1979; Proceedings to permit operation after post-TMI shutdown Order; Intervenors Commonwealth of Pennsylvania, UCS, TMI Alert, Mr.& Mrs. Aamodt. Commission authorized operation.

San Onofre Unit 1 - 1984; Seismic shutdown Order recission; Hearing requested by Sierra Club et.al. Commission denied request for hearing and authorized operation.

We also looked at 81 published Director's Decisions issued since February, 1979 that relate to power reactors. In 30 of those cases, petitioners made requests under 10 CFR § 2.206 that could fairly be construed as requests for adjudicatory hearings. (Petitioners rarely used the word "adjudicatory".)

A brief explanation of the process associated with petitions filed under 10 CFR § 2.206 is called for. Under 10 CFR 2.206, <u>any person</u> may file a request with an NRC director "...to institute a proceeding pursuant to § 2.202 [Orders to Show Cause] to modify, suspend or revoke a license, or for such other action

QUESTION 3. (Continued) 3

as may be proper." There is no requirement for the petitioner to demonstrate a legal interest in the matters raised in the petition.

Only if the NRC institutes a proceeding in response to the 2.206 petition, will members of the public be given an opportunity to request a hearing and demonstrate the requisite legal interest in the proceeding so as to be allowed to intervene. The demonstration of requisite interest is not affected by the fact that the petitioner to intervene had filed a 2.206 petition; it is an independent requirement.

Thus, granting an adjudicatory hearing directly in response to a 2.206 petition would be legally inappropriate. The reason is that a 2.206 petitioner has no right to a hearing. Illinois v. NRC, 591 F.2d 12, 14 (7th Cir. 1979). For this reason, the NRC has never granted an adjudicatory hearing in direct response to the request of a 2.206 petitioner.

Nevertheless, in two instances, requests by petitioners did indirectly result in adjudicatory hearings. In one case, an Order to Show Cause issued in response to a petition resulted in a proceeding. See Dairyland Power Cooperative (LaCrosse Boiling Water Reactor), DD80-9, 11 NRC 392 (1980). In a second case the Commission decided to hold a discretionary adjudication to resolve safety issues raised by a petition and Director's Decision responding to the petition. See Consolidated Edison Co. of New York Inc. (Indian Point Unit No. 3), DD-80-55, 11 NRC 351 (1980). See also Consolidated Edison Co. of New York Inc. (Indian Point Unit No. 3), CLI-81-1, 13 NRC 1 (1981).

QUESTION 4. You may be aware that the Massachusetts State Legislature is considering a bill which would expand the Emergency Planning Zone around nuclear power plants in Massachusetts to 50 miles. Would the NRC support this initiative?

ANSWER.

It is the NRC view that the current detailed planning requirements for the 10-mile plume exposure pathway EPZ and 50-mile ingestion exposure pathway EPZ are adequate to assure that prompt and effective actions can be taken to protect the public in the event of an accident. We do not believe there is a need from a public health and safety standpoint to expand the 10-mile plume exposure pathway EPZ around nuclear power plants to 50 miles. However, this does not preclude a State and utility from working together to develop supplemental planning for the plume exposure pathway for areas beyond 10 miles if they so desire.

QUESTION 5. In your prepared statement you said, "The NRC will not permit the facility (Pilgrim) to resume operation until corrective actions satisfactory to the NRC have been taken to address the Emergency Planning deficiencies identified by FEMA". Have those corrective actions been taken? You also indicated that the NRC would allow the plant to restart without the resolution of all Emergency Planning deficiencies. What deficiencies would the NRC allow to be left unresolved at restart?

ANSWER.

Progress has been made to date toward improving the offsite emergency preparedness programs at Pilgrim and correcting the emergency planning deficiencies identified by FEMA. Drafts of the local emergency plans have been completed and six of these plans have been forwarded by the Commonwealth to FEMA for informal technical review. The draft Massachusetts Civil Defense Agency Area II plan has essentially been completed and is being reviewed by the Commonwealth. The draft of the Commonwealth plan for Pilgrim is nearing completion.

As indicated in the testimony, the NRC may authorize restart with some planning issues not fully resolved. In reaching this decision, the NRC will examine each planning deficiency and weigh the significance of the deficiency, the nature of any compensatory actions, and the progress being made by the Commonwealth, local governments and the licensee toward correction of the deficiency. Our apporach to these issues is not unique to the Pilgrim facility. A similiar process occurs at all operating nuclear plant sites in the

QUESTION 5. (Continued) 2

United States because of the dynamic nature of the emergency planning process. In practice, we expect that emergency response plans will be revised and improved on a continual basis. Deficiencies identified during the ongoing review process and in biennial exercises at each of these sites are assessed for significance and plants may be allowed to operate while the deficiencies are being corrected. Given the progress to date at Pilgrim, it is premature at this time to attempt to determine which, if any, deficiencies will remain when restart decisions are to be made. However, the NRC will give special attention to the corrective actions involving the emergency response plans for schools and day care centers as well as the emergency response plans for special-needs and transport-dependent populations in the plume exposure pathway emergency planning zone.

QUESTION 6. You said in your testimony that a detailed team inspection will be performed at Pilgrim prior to a restart decision. Has that inspection commenced? When will it conclude? How long will the public have to review the NRC's findings relative to the inspection and prior to a restart decision?

ANSWER.

Prior to consideration of Pilgrim plant restart, the NRC will conduct an Integrated Assessment Team Inspection (IATI) at Pilgrim to review and evaluate the effectiveness of licensee corrective action programs in order to determine the readiness of the plant and licensee personnel to support the restart and safe operation of Pilgrim. The inspection will encompass a three week period and is tentatively scheduled for June 1988, based on a projection of licensee activities. It is expected that the report documenting the findings of the team will be issued approximately one month prior to the planned public Commission meeting to consider a restart decision. As noted in our response to question 1, the NRC will hold a public meeting in the Plymouth area in July or August 1988 on the findings of the inspection team.

QUESTION 7. A great deal of public concern has focused on a release of radioactive resin which occurred at Pilgrim in the summer of 1982. It is my understanding that radioactive resin was found on the rooftops of buildings owned by Boston Edison. Would you please provide all the data the NRC has on file (including onsite and offsite readings, dosimeter readings and stack readings) indicating what the level of radioactivity had been in the period of time when the resin was released.

ANSWER.

In response to your request, we have made a comprehensive search of our files regarding information on the radioactive resin release at the Pilgrim Station. Enclosed are all the documents which were found as a result of this search.

Enclosures 1 and 3 provide the most detail concerning the event itself. Figure 1 of Enclosure 1 indicates the extent of the contamination by the resin found on June 11, 1982. All contamination found was within the site boundary. Figure 1 of Enclosure 1 provides a detailed map, but basically contamination was found as follows:

QUESTION 7. (Continued) 2

Location	Activity in disintegrations per minute (DPM)*
Administration Building Roof	100,000 - 200,000 DPM
Turbine Building	100,000 DPM
AOG Building	200,000 DPM
Retube Building	200,000 DPM
Main Transformer Area	1,000 - 25,000 DPM
Pavement curb near Retube Building	20,000 - 80,000 DPM
Pavement curb near Administration Building	100,000 - 200,000 DPM

Enclosures:

1. Inspection Report No. 50-293/82-20, dated August 5, 1982.
2. Letter from R. W. Starostecki, NRC, to W. D. Harrington, BECo, dated June 16, 1982.
3. Letter from J. E. Howard, BECo, to R. W. Starostecki, NRC, dated July 15, 1982.
4. NUREG-0837, "NRC TLD Direct Radiation Monitoring Network," Progress Reports for January through September 1982, Vol. 2 Nos. 1, 2, and 3.
5. Memorandum from R. J. Mattson, NRC, to H. R. Denton, NRC, "Generic Implications of the Release of Spent Demineralizer Resins from Pilgrim, Unit No. 1," dated July 8, 1982.

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*In discrete small piles of resin of several grams.

QUESTION 7. (Continued) 3

6. Memorandum from J. L. Pellet, NRC, to K. V. Seyfrit, NRC, "Technical Review Report on Pilgrim 1 Resin Migration," dated April 19, 1983.

7. Event Evaluation Sheet, "Spent Resin Release," dated June 14, 1982.

8. IE Information Notice No. 82-43, "Deficiencies in LWR Air Filtration/Ventilation Systems," dated November 16, 1982.

9. Pilgrim Nuclear Power Station, "Radioactive Effluent and Waste Disposal Report Including Radiological Impact on Humans," January 1 through June 30, 1982, dated September 1, 1982.

10. Pilgrim Nuclear Power Station, "Radioactive Effluent and Waste Disposal Report Including Radiological Impact on Humans," July 1 through December 30, 1982, dated March 1, 1983.

ENCLOSURE 1
TO QUESTION 7

Report No. 50-293/82-20

Docket No. 50-293

License No. DPR-35 Priority -- Category C

Licensee: Boston Edison Company

800 Boylston Street

Boston, Massachusetts 02199

Facility Name: Pilgrim Nuclear Power Station

Inspection At: Plymouth, Massachusetts

Inspection Conducted: June 11-13, 1982

Inspectors: R.L Nimitz 8/5/82
R. L. Nimitz, Radiation Specialist date

M McBride 8/5/82
M. H. McBride, Ph.D., Radiation Specialist date

R.L Nimitz for 8/5/82
J. J. Kottan, Radiation Laboratory Specialist date

Approved by: Edward A. Greenman 8-6-82
E. G. Greenman, Acting Chief, Facilities Radiation Protection Section date

Inspection Summary:
Inspection on June 11-13, 1982 (Inspection Report No. 50-293/82-20)
Areas Inspected: Special, announced inspection of initial licensee actions after spent resin was found on roof-tops and pavement within the protected area of the Pilgrim Station on June 11, 1982. Areas inspected included: initial contamination identification, contamination surveys, posting and barricading, resin removal, resin source determination, notifications and initial and long term planned corrective actions. Upon arrival at the site at 10:30 p.m. on June 11, 1982, the inspectors toured the site to review the extent and control of the resin contamination. The inspection involved 33 inspector-hours onsite by three region-based inspectors.
Results: No violations were identified.

DETAILS

1. Persons Contacted

W. Armstrong, Deputy Manager, Nuclear Operations
W. Anderson, Watch Engineer
J. Bunning, HVAC Supervisor, Johnson Controls
L. Dooley, Health Physics Engineer
B. Elderidge, Senior Radiological Engineer
J. Frazer, Instrumentation and Control Supervisor
*R. Machon, Nuclear Operations Manager
*C. Mathis, Deputy - Nuclear Operations Manager
A. Richards, Health Physics Engineer
K. Roberts, Chief Maintenance Engineer
J. Smallwood, Chemical Engineer
*P. Smith, Chief Technical Engineer
V. Stagliola, Senior Waste Management Engineer

*denotes those persons attending the exit interview on June 13, 1982

The inspector also contacted other licensee personnel during the inspection.

2. Purpose

The purpose of this special inspection was to review the licensee's actions after spent resin was found on roof-tops and pavement within the Protected Area of the Pilgrim Station on June 11, 1982.

3. Description of Identification

During a tour of the Retube Building Roof (see Figure 1) at about 1:00 p.m. on June 11, 1982, a Radiation Protection Technician saw resin in the building's rain gutters. Subsequent contamination surveys of small piles of the resin (about several grams) indicated activity levels of 100-200,000 disintegrations per minute (DPM).

4. Inspector Review

The inspectors reviewed the following licensee actions taken after identification of the spent resin.

4.1 Contamination Surveys

The review of this area indicated that, when the resin was found the licensee immediately performed surveys of the entire Protected Area and selected areas of the Licensee Controlled Area. The surveys were completed within about 2 hours of initial identification of the resin.

Areas surveyed included: roof-tops of other buildings, pavement areas, storm drains, security access area, parking lots, automobiles and the shore front area.

The licensee identified resin contamination on the Reactor, Turbine, Administration, and Augmented Off-Gas Buildings. Resin was also identified on two areas of pavement (see Figure 1).

No resin contamination was found off site or in the storm drains.

Based on this review, the licensee performed adequate initial contamination surveys to define the extent of resin contamination.

No violations were identified.

4.2 Personnel Contamination Surveys

The licensee's normal personnel contamination survey requirements includes the requirement that personnel exiting the Controlled Area perform a complete whole body frisk. In addition, personnel are required to pass through high sensitivity portal monitors at the security access/egress area.

Subsequent to the resin identification, the licensee initiated a requirement that all personnel exiting the security access/egress area perform contamination surveys of their shoes with a thin window detector. The requirement to perform the additional surveys was implemented within about two hours after the initial identification. No shoe contamination was identified.

No violations were identified.

4.3 Posting and Barricading

The review of the posting and barricading of selected contaminated areas, indicated the licensee had posted and barricaded the areas in an expeditious manner and in accordance with station procedures.

No violations were identified.

4.4 Spent Resin Removal

The review of this area indicated the licensee initiated vacuuming of the resin from the contaminated areas and from the Reactor Building Contaminated Ventilation Exhaust System in an expeditious manner.

To further expedite the clean-up operation, the licensee ordered additional vacuum cleaners. These vacuum cleaners were to be flown in by airplane.

During removal of resins from the pavement and roof-top areas, the licensee also collected airborne radioactivity samples. No airborne radioactivity was identified.

4.5 Source Identification/Initial Corrective Action

The inspectors' review of licensee actions taken following identification of the spent resin indicated that the licensee immediately initiated an investigation to determine the source of the resin contamination.

The licensee's initial findings indicated the resin was entering the ventilation system during resin cleaning operations. The licensee subsequently suspended all operations which could result in further resin releases to ventilation system duct work. Figure 2 provides the apparent resin contamination/release pathway.

The inspector's discussions with licensee representatives regarding the initial identification of spent resin in the ventilation system showed that spent resin had been identified in the ventilation system prior to the identification of the resin on roof-tops. The inspector also noted that dry radioactive resin was found in the "B" Stand By Gas Treatment (SBGT) System on September 27, 1981. (Inspection Report 50-293/82-01).

The SBGT System exhausts air from contaminated ventilation systems in the Reactor Building as does the Reactor Building Contaminated Area Exhaust System. Consequently, the inspector noted the identification of spent resin in the SBGT System would serve as an indication of possible resin contamination of the Reactor Building Contaminated Area Exhaust System. The latter system vents to atmosphere via the Reactor Building Vent Stack.

Licensee representatives stated that in September 1981, the Reactor Building Contaminated Area Exhaust Filters were found to be bypassing, apparently due to improper filter fit and degradation and were subsequently replaced. The licensee representatives stated that the contamination most likely exited the plant vent via the by-pass prior to the repair of the filters.

The inspector indicated that circumstances surrounding the initial ventilation system contamination and the licensee's actions taken would be reviewed further during a subsequent inspection. (50-293/82-20-01)

4.6 Notifications

The inspectors reviewed the identification of the spent resin event with respect to the requirements of 10 CFR 50.72, "Notification of significant events." Upon evaluation it was determined that the detection of the contamination did not constitute a significant event as described in 10 CFR 50.72.

Inspector discussions with the Pilgrim Station Senior Resident Inspector indicated that he noted additional personnel activity (about one hour after the licensee's initial discovery) and questioned licensee representatives regarding this activity. Licensee representatives stated that the additional activity was the result of resin identification on roof-tops.

The Senior Resident Inspector subsequently notified NRC Region I. The licensee also notified the NRC Operations Center of the resin contamination.

No violations were identified.

5. <u>Long Term Corrective Action</u>

The inspector met with licensee representatives on June 13, 1982 to discuss the licensee's plans for long term corrective actions.

As a result of these discussions and a followup telephone conversation on June 15, 1982 between the Director, Division of Project and Resident Programs, NRC Region I and the licensee, a Confirmatory Action Letter (No. CAL 82-19) dated June 16, 1982, was sent to the licensee to document the NRC's understanding of planned actions.

The letter stated the NRC understanding that the licensee would undertake and complete the following actions:

- Discontinue back flushing, regenerating or ultrasonically cleaning condensate demineralizer spent resins until the source of the resin contamination of ventilation systems is identified and corrective actions taken for its cause. In the event long term plant design changes are needed to correct the cause of the resin release to the ventilation system, resin cleaning operations may be performed provided that: a) appropriate procedure revisions and other administrative controls are established to prevent further resin releases to the ventilation system; b) a test of the adequacy of the procedure revisions and other administrative controls is performed using clean resin and; c) the integrity of the Contaminated Exhaust Ventilation filters has been verified by DOP testing.

- Inspect or test all potentially effected safety-related ventilation system components (e.g. Secondary Containment Isolation Dampers) to verify their operability and the absence of resin. In the event resin contamination is identified, the resin will be removed. The results of this inspection shall be documented for subsequent NRC review.

- Inspect clean air intake ventilation filters or ducts for all potentially effected station structures to verify absence of resin. In the event resin contamination is identified, the resin will be removed. The results of this inspection shall be documented for subsequent NRC review.

- Inspect the Reactor Building plant vent monitor to verify its operability and the absence of resin in the sampling system. The results of this inspection shall be documented for subsequent NRC review.

- Establish a surveillance and preventative maintenance program for contaminated ventilation exhaust systems to ensure exhaust filter integrity. This program will also include provisions for system inspection to identify resin accumulation.

- Provide to the NRC Region I office by July 15, 1982 a report detailing the history and extent of the duct contamination, its causes, and the circumstances surrounding the release of radioactive material. This report will also describe the corrective actions taken and the additional management oversight initiated to prevent recurrence.

The licensee provided the requested report in a letter dated July 15, 1982. The licensee's implementation of the remaining NRC understanding will be reviewed during a subsequent inspection (50-293/82-20-02).

6. Exit Interview

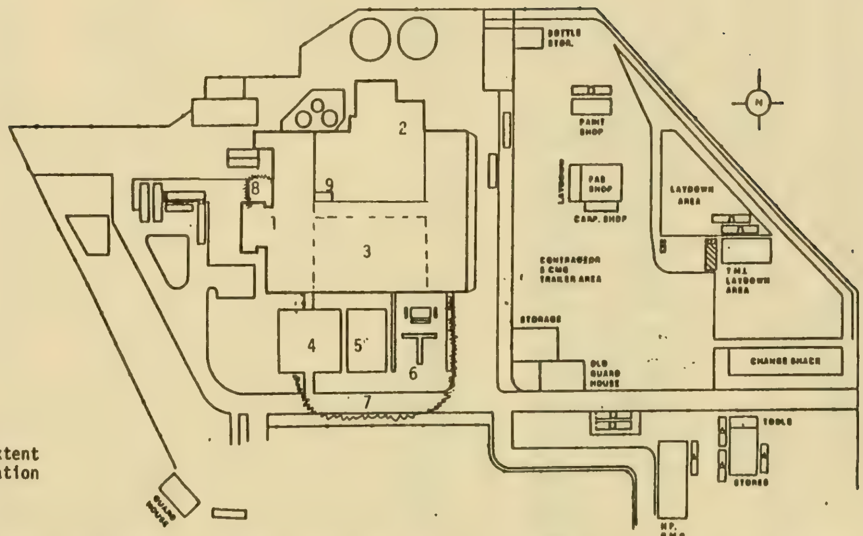
The inspector met with licensee representatives (denoted in Section 1 of this report) on June 13, 1982. The inspector summarized the scope and findings of the inspection.

FIGURE 1

PILGRIM STATION SITE PLAN

SPENT RESIN CONTAMINATION
LEVELS

JUNE 11, 1982



Indicates extent
of contamination

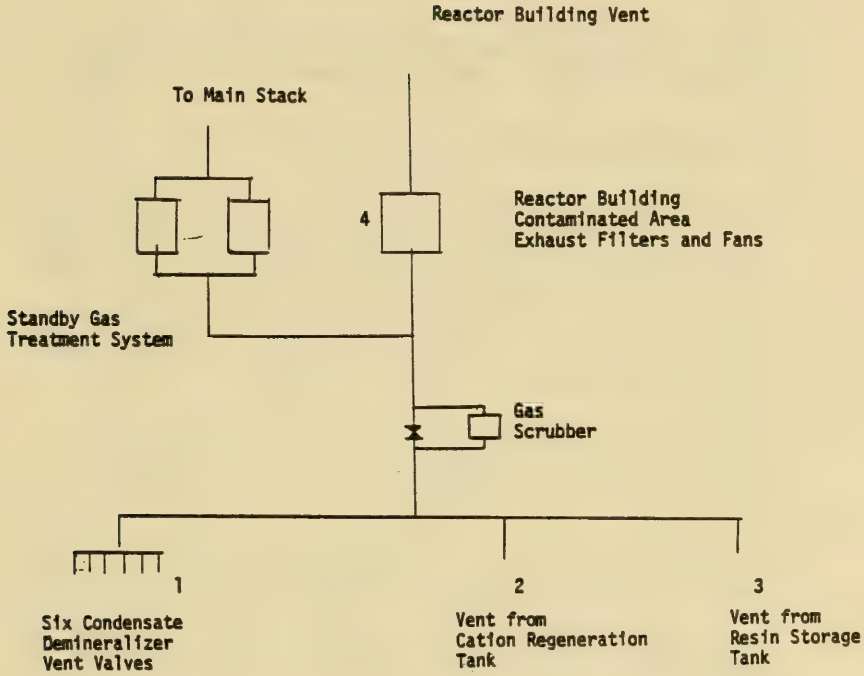
1. Administration Building Roof - pockets, 100K - 200K dpm
2. Reactor Building Roof - clean
3. Turbine Building Roof - pockets, 100K dpm
4. AOG Building - pockets, 200K dpm
5. Retube Building - pockets, 200K dpm
6. Main Transformer Area - 1K - 25K dpm (small areas)
7. Pavement - along curb, 20K - 80K dpm
8. Pavement - along curb, 100K - 200K dpm
9. Plant Vent - Point of Release

*Assumed 10% Detector Efficiency

FIGURE 2

SPENT RESIN CONTAMINATION/RELEASE

PATHWAY



1. Possible source prior to repair.
2. Apparent source during backwashing.
3. Possible source during resin transfer
4. Filters found to be by-passing about September 1981.

16 JUN 1982

ENCLOSURE 2
TO QUESTION 7

Docket No. 50-293
CAL No. 82-19

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
25 Braintree Hill Office Park
Braintree, Massachusetts 02184

Gentlemen:

This refers to our telephone conversation on June 15, 1982 regarding the identification of spent resin on roof-tops and pavement within the protected area of the Pilgrim Station on June 11, 1982.

With regard to the matters discussed, we understand that you have undertaken or will undertake and complete the following actions:

1. Discontinue back flushing, regenerating or ultrasonically cleaning condensate demineralizer spent resins until the source of the resin contamination of ventilation systems is identified and corrective actions taken for its cause. In the event long term plant design changes are needed to correct the cause of the resin release to the ventilation system, resin cleaning operations may be performed provided that: a) appropriate procedure revisions and other administrative controls are established to prevent further resin releases to the ventilation system; b) a test of the adequacy of the procedure revisions and other administrative controls is performed using clean resin and; c) the integrity of the Contaminated Exhaust Ventilation filters has been verified by DOP testing.

2. Inspect or test all potentially effected safety related ventilation system components (e.g. Secondary Containment Isolation Dampers) to verify their operability and the absence of resin. The results of the inspections/tests shall be documented for subsequent NRC review.

3. Inspect clean air intake ventilation filters or ducts for all potentially effected station structures to verify absence of resin. In the event resin contamination is identified, the resin will be removed. The results of this inspection shall be documented for subsequent NRC review.

4. Inspect the Reactor Building Plant vent monitor to verify its operability and the absence of resin in the sampling system. The results of this inspection shall be documented for subsequent NRC review.

OFFICIAL RECORD COPY

16 [illegible]

5. Establish a surveillance and preventative maintenance program for contaminate ventilation exhaust systems to ensure exhaust filter integrity. This program will also include provisions for system inspection to identify resin accumulation.

6. Provide to this office by July 15, 1982 a report detailing the history and extent of the duct contamination, its causes, the circumstances surrounding the release of the resin, and the amount and extent of onsite and offsite releases of radioactive material. This report will also describe the corrective actions taken and the additional management oversight initiated to prevent recurrence.

The response directed by this letter is not subject to the clearance procedures of the Office of Management and Budget as required by the Paperwork Reduction Act of 1980, PL 96-511.

If our understanding of your planned actions described above is not in accordance with your actual plans and actions being implemented, please notify this office by telephone within 24 hours of your receipt of this letter.

Your cooperation with us in this matter is appreciated.

Sincerely,

for E. J. Brunner

Richard W. Starostecki, Director
Division of Project and Resident Programs

cc w/encl:
A. V. Morisi, Manager, Nuclear Operations Support
R. D. Machon, Nuclear Operations Manager - Pilgrim Station
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)
NRC Resident Inspector

bcc w/encl:
Region I Docket Room (with concurrences)

R. Carlson
E. Brunner
E. Greenman
T. Martin
R. Haynes

MAR 22 '88 11:04 PILGRIM NRC RESIDENT

ENCLOSURE 3
TO QUESTION 7

BOSTON EDISON COMPANY
800 BOYLSTON STREET
BOSTON, MASSACHUSETTS 02199

July 15, 1982

BECo. Ltr. #82-194

Mr. Richard W. Starostecki, Director
Division of Project and Resident Programs
Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA. 19406

License No. DPR-35
Docket No. 50-293

Response to CAL #82-19

Reference (A) NRC letter (R. Starostecki) to BECo (W. Harrington), CAL #82-19, dated June 16, 1982

Dear Sir:

This letter provides our response to Reference (A), Item 6, regarding the identification of spent resin on roof tops and pavement within the protected area of Pilgrim Nuclear Power Station on June 11, 1982.

Response

1. History and Causes

The Condensate Demineralizer System has been identified as the source of the resin contamination found in the ductwork. More specifically, the processes associated with condensate demineralizer resin backwash/transfer have been determined as the causal factors as discussed below:

During resin transfer operations into a condensate demineralizer, the vent valve is open to allow proper resin sluicing and subsequent filling with water. Condensate demineralizer venting occurs sequentially via 1) common vent header, 2) gas scrubber, 3) reactor building contaminated exhaust system and 4) standby gas treatment system. (Attachments A & E)

For the fill step, gas scrubber readings are utilized by the operator for indication of a "Full" demineralizer. However, because of excess water carry-over into the scrubber and beyond, water could flood through the scrubber and into the ventilation ductwork on El. 23' of the reactor building, depositing any entrained resin in the ductwork and ultimately, after drying, in the Standby Gas Treatment System.

During resin backwash operations, the "Cation" or "Storage" tank, by system design (Attachment B), warrant the respective vent valve to be in the open position for venting through the upstream gas scrubber. Small amounts of resin are sometimes entrained in the air and water sluice, which could gain access to the contaminated exhaust vent plenum as discussed above.

2. Extent of Duct Contamination

Attachment D shows the extent of duct contamination from the sources (Condensate Demineralizers) to the Reactor Building Vent Stack. It also shows the amount of resin collected from June 12, 1982 to July 13, 1982.

Since the contaminated exhaust filters were found to be degraded and replaced on March 15, 1982, and since the analysis of the resin indicated that it was at least a year old, it was concluded that the most likely pathway of the resin was from the condensate demineralizer vent to the contaminated exhaust plenum, through the contaminated exhaust filters and out the Reactor Building Vent Stack.

3. Circumstances Surrounding Release of Resins

The circumstances surrounding the release of resin can be attributed to several factors. As mentioned earlier, condensate demineralizer backwash operations and problems with the condensate demineralizer system vents were primary factors.

In order to maintain condensate demineralizers operating within low differential values, so as to attain maximum filter capabilities while minimizing crud loading of the reactor vessel and attendant radiation exposures, numerous backwashes of the condensate demineralizer beds were required during the ascension to power from extended refuel outages. The resin beads that had accumulated in the vent ducting over the years were hastened in their migration by the repeated venting operations and by virtue of SGTS testing using a common ventilation plenum allowing the entrained resin beads to pass into the Reactor Building Ventilation.

The initial identification of the release was observed by a health physics technician on June 11, 1982 while collecting random samples on top of the Condenser Retube Building, as part of a general site survey.

4. Amount and Extent of Onsite and Offsite Releases

An extensive survey was conducted both onsite and offsite. Small quantities of resins were detected on sections within the protected area to the south and west of the plant. Attachment C shows onsite areas where resin was discovered. The total amount of resin found outside the process buildings was less than one cubic foot. Health physics technicians surveyed and checked personnel and

vehicles in the parking lot with no measurable results. The storm drain outlet to the Discharge Canal was checked with no measurable results. A fine mesh screen was affixed to all storm drains to contain resin within the protected area. In situ soil analyses conducted in selected areas outside the Protected Area resulted in no detectable activity above historic levels. The shorefront area and the main stack area were also checked which resulted in no activity above background. A complete list of samples taken including isotopic analyses is available for review.

In total, less than one (1) cubic foot of resin was found inside the protected area fencing and less than (70) cubic feet was found and removed from inside the ventilation system. (Attachment D)

5. Corrective Actions Taken

Our immediate corrective actions were to conduct an extensive survey of affected areas, commence cleanup operations, and identify and secure the resin source. The Condensate Demineralizer System was identified as the resin source and was secured to preclude further backwashing or venting activities until procedures and/or temporary modifications could be implemented to ensure that no more resin would be admitted to the ventilation ducting.

The vent to the ducting was blanked off under Temporary Modification TM 82-39 and a Temporary Procedure TP 82-44 was written to address the operational aspects necessary to prevent carryover of resins. The Temporary Procedure was finalized utilizing a clean (new) charge of resin before condensate deminieralizer operation was allowed again.

The integrity of the contaminated exhaust ventilation filters was verified by DOP testing (Procedure #7.1.30), on June 14, 1982 and found to be 99.95% particulate efficient for both banks. Potentially affected safety-related ventilation system components were inspected or tested to verify their operability and the absence of resin. Clean air intake filters and ducts were inspected to verify absence of resin. The Reactor Building Vent monitor was inspected to verify operability. The inspection found the system to be operable.

The long term corrective actions to prevent recurrence currently in place or under consideration are: 1) changes to the operating procedure, i.e. restricting times and flows during backwashes and transfers to minimize resin volume with the cation tank; 2) a plant design change to the existing gas scrubber so as to provide a larger volume, two levels of phase separation and a final stage screen to trap the resin; and 3) the condensate demineralizer vent system will be vented to the TIP Room rather than directly to the ventilation ducting.

In addition, a ventilation system inspection program has been established to identify and remove any remaining resin from the ventilation system. The integrity of the contaminated exhaust filters will be verified by visual inspection on a six month basis.

We believe these actions to be prudent and effective measures to assure that the condensate demineralizer resins will not be entrained in the plant ventilation systems in the future.

6. <u>Additional Management Oversight Initiated</u>

Boston Edison Company, in response to an Order modifying our License, has committed to improve the Corrective Action Program through a Performance Improvement Program (PIP). In Sections III.1.C.3 and III.1.C.4 of the PIP, we have made commitments to identify weaknesses and determine alternatives for improvements. This determination will include 1) Management Systems involved in Corrective Action Program, 2) Forms and Reports including Status Reports, 3) Latest Trend Analysis, 4) Informational sources and 5) Evaluation of communication methods and uses.

In addition, revision to the Corrective Action System design will be developed around a "universal carrier form" on which to identify report problems/events. The use of this report/follow-up mechanism will be procedurally addressed. The origin of some of the elements which will revise the Corrective Action System are based on our recent knowledge of a Corrective Action System used by another Utility, currently under review by Boston Edison Company.

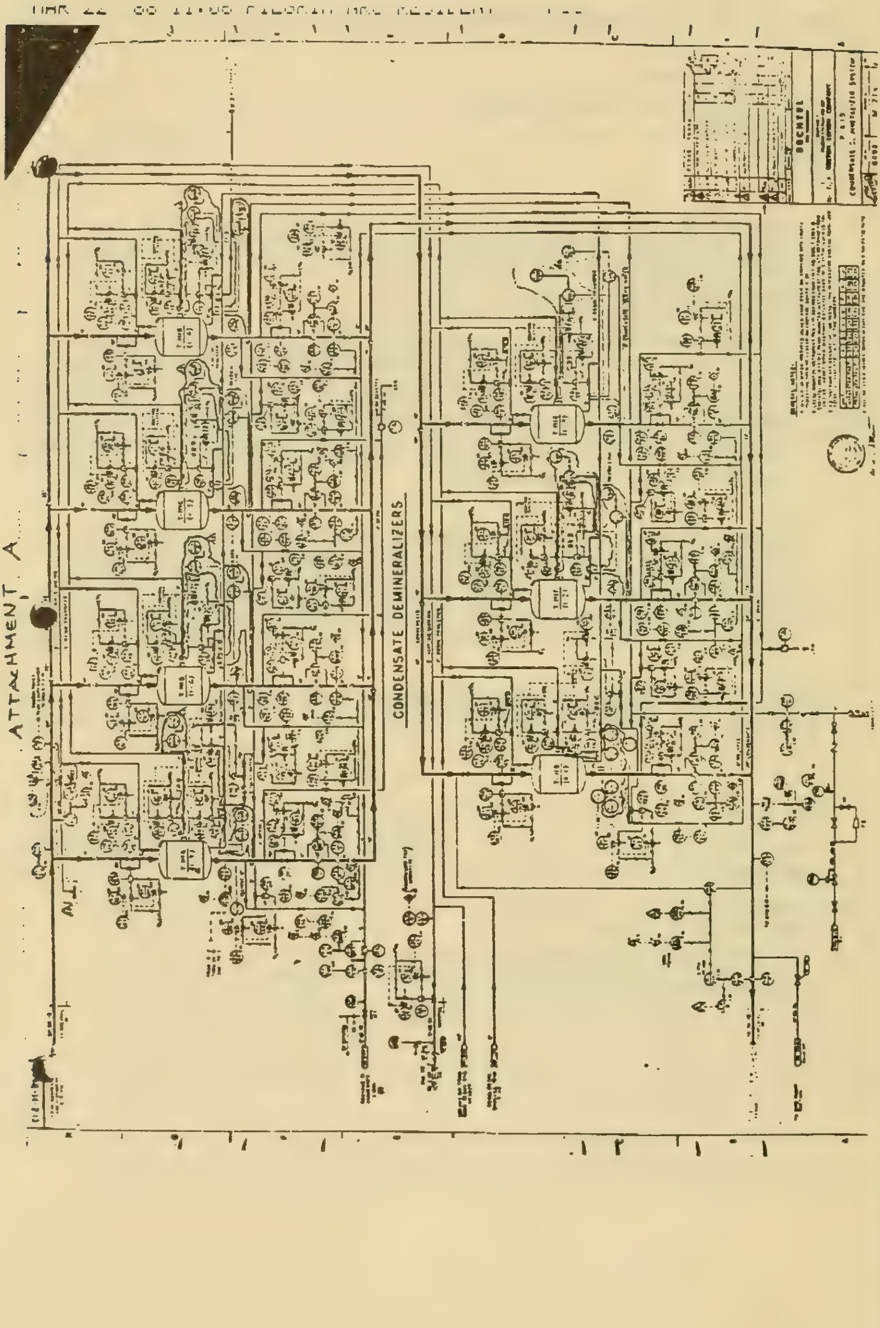
We believe this information adequately addresses the Reference A concerns; however, should you have additional questions on this subject, please do not hesitate to contact us.

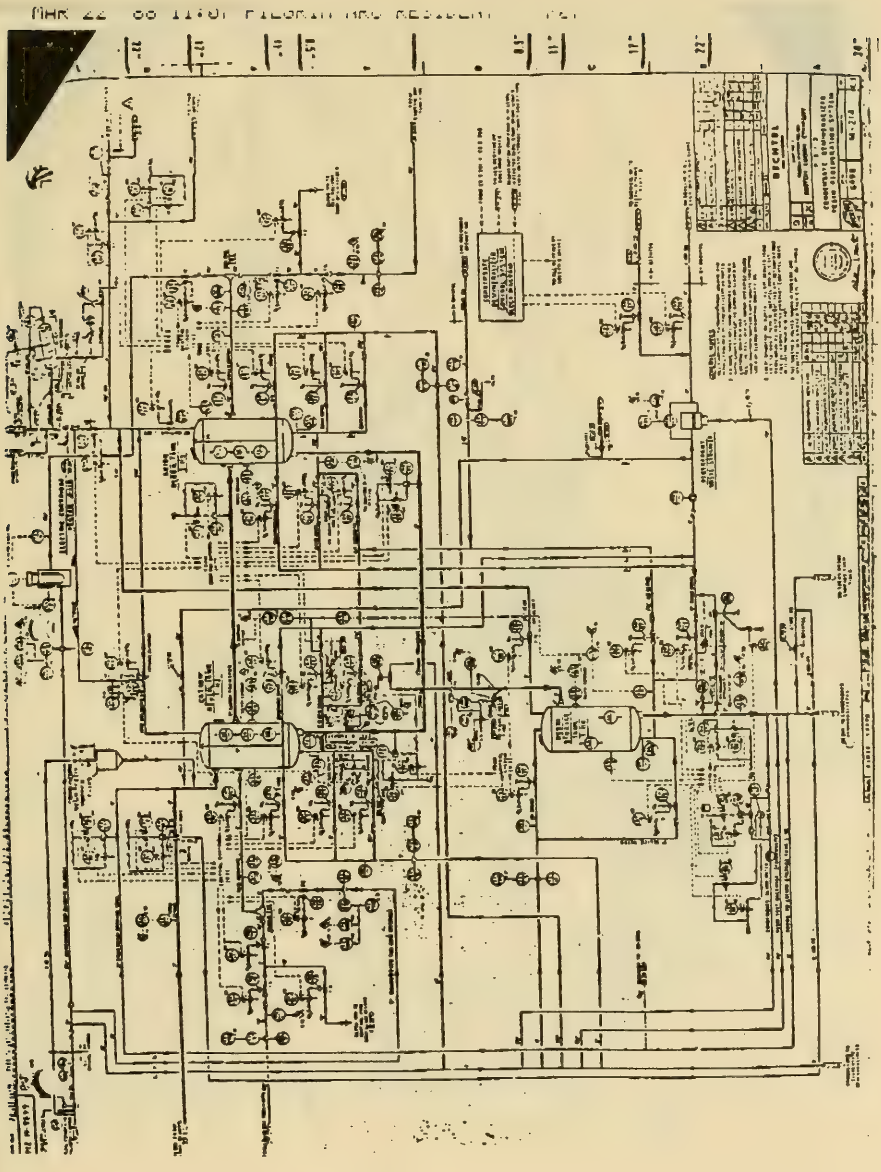
Very truly yours,

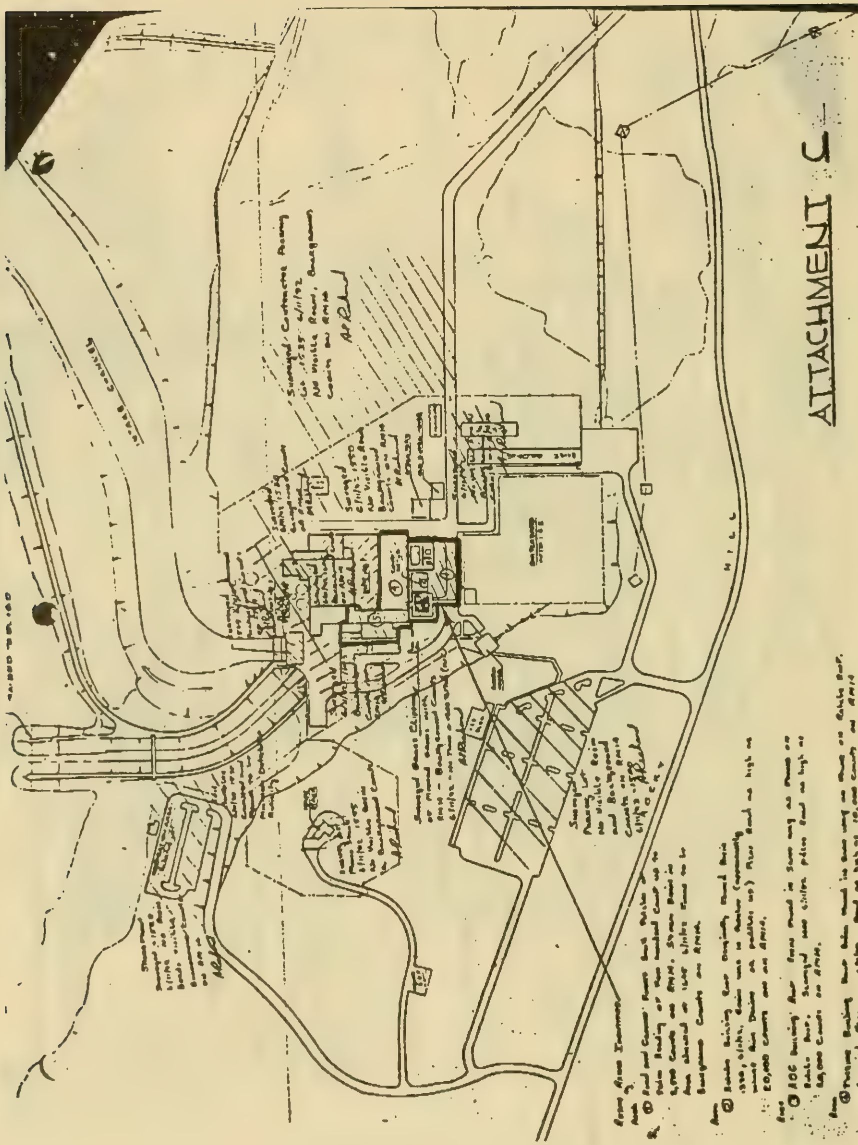
J Edward Howard

Attachments:

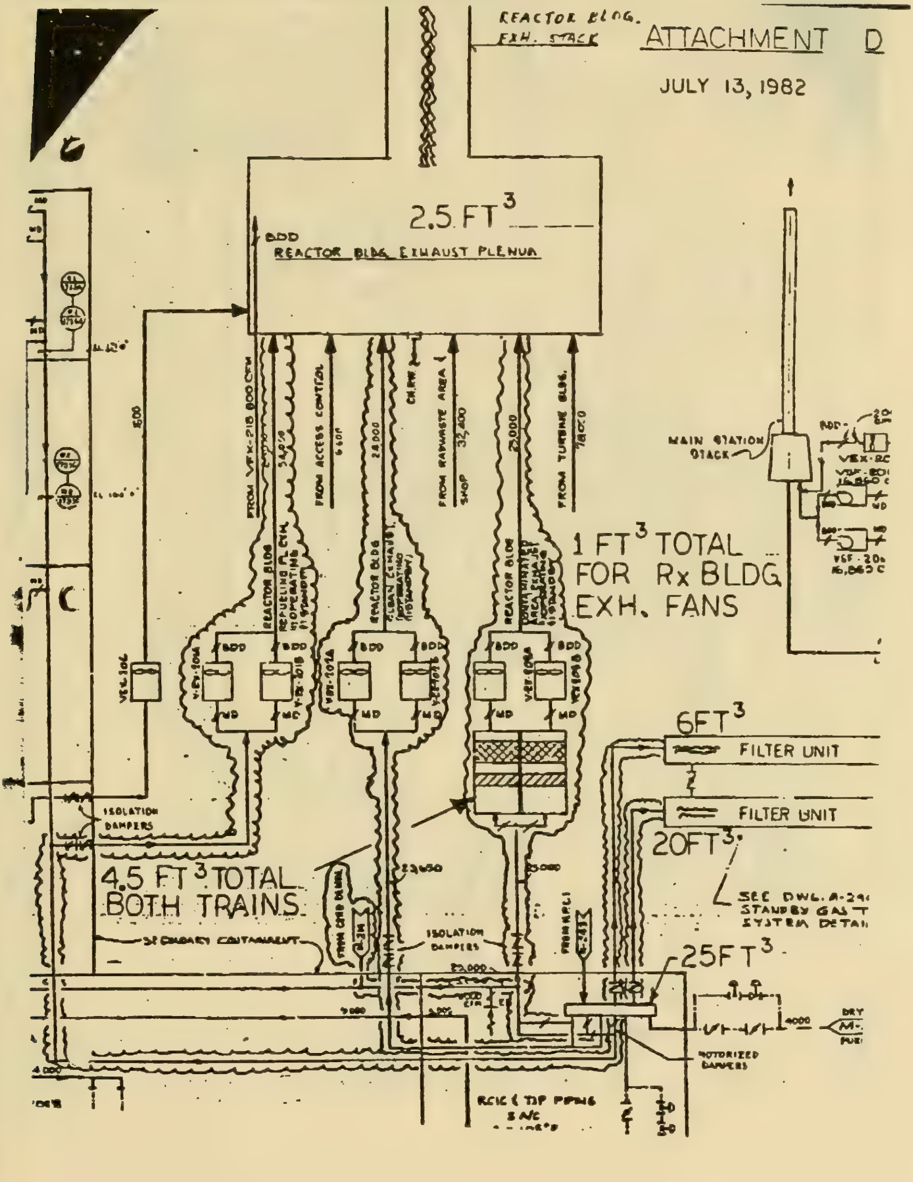
(A) P&ID #M-213
(B) P&ID #M-214
(C) Location of onsite Resin Discoveries
(D) Sketch of Resin Discoveries in Ventilation System
(E) P&ID #M-294

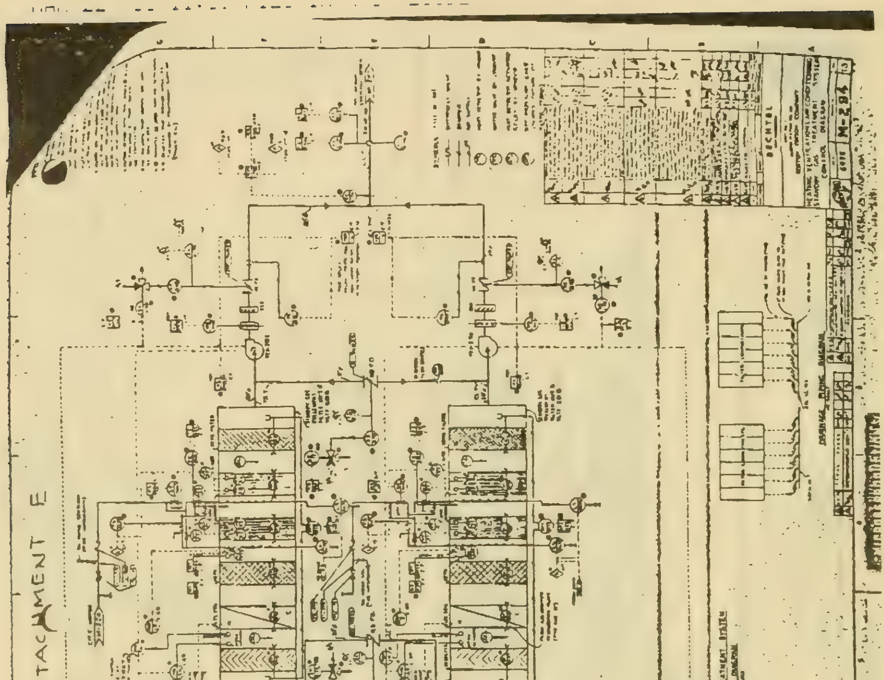

ATTACHMENT A
CONDENSATE DEMINERALIZERS




ATTACHMENT C

MAR 22 '88 11:09 PILGRIM NRC RESIDENT




ATTACHMENT E
M-2984

MAR 22 '88 11:10 PILGRIM NRC RESIDENT P11

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
631 PARK AVENUE
KING OF PRUSSIA, PENNSYLVANIA 19406

16 JUN 1982

Docket No. 50-293
CAL No. 82-19

Boston Edison Company M/C Nuclear
ATTN: Mr. William D. Harrington
Senior Vice President, Nuclear
25 Braintree Hill Office Park
Braintree, Massachusetts 02184

RECEIVED
'82 JUN 21 AM 10 35
PILGRIM STATION
NUCLEAR RECORDS CENTER

Gentlemen:

This refers to our telephone conversation on June 15, 1982 regarding the identification of spent resin on roof-tops and pavement within the protected area of the Pilgrim Station on June 11, 1982.

With regard to the matters discussed, we understand that you have undertaken or will undertake and complete the following actions:

1. Discontinue back flushing, regenerating or ultrasonically cleaning condensate demineralizer spent resins until the source of the resin contamination of ventilation systems is identified and corrective actions taken for its cause. In the event long term plant design changes are needed to correct the cause of the resin release to the ventilation system, resin cleaning operations may be performed provided that: a) appropriate procedure revisions and other administrative controls are established to prevent further resin releases to the ventilation system; b) a test of the adequacy of the procedure revisions and other administrative controls is performed using clean resin and; c) the integrity of the Contaminated Exhaust Ventilation filters has been verified by DOP testing.

2. Inspect or test all potentially effected safety related ventilation system components (e.g. Secondary Containment Isolation Dampers) to verify their operability and the absence of resin. The results of the inspections/tests shall be documented for subsequent NRC review.

3. Inspect clean air intake ventilation filters or ducts for all potentially effected station structures to verify absence of resin. In the event resin contamination is identified, the resin will be removed. The results of this inspection shall be documented for subsequent NRC review.

4. Inspect the Reactor Building Plant vent monitor to verify its operability and the absence of resin in the sampling system. The results of this inspection shall be documented for subsequent NRC review.

MAR 22 '88 11:11 PILGRIM NRC RESIDENT P12

16 JUN 1982

Boston Edison Company M/C Nuclear 2

5. Establish a surveillance and preventative maintenance program for contaminated ventilation exhaust systems to ensure exhaust filter integrity. This program will also include provisions for system inspection to identify resin accumulation.

6. Provide to this office by July 15, 1982 a report detailing the history and extent of the duct contamination, its causes, the circumstances surrounding the release of the resin, and the amount and extent of onsite and offsite releases of radioactive material. This report will also describe the corrective actions taken and the additional management oversight initiated to prevent recurrence.

The response directed by this letter is not subject to the clearance procedures of the Office of Management and Budget as required by the Paperwork Reduction Act of 1980, PL 96-511.

If our understanding of your planned actions described above is not in accordance with your actual plans and actions being implemented, please notify this office by telephone within 24 hours of your receipt of this letter.

Your cooperation with us in this matter is appreciated.

Sincerely,

for Richard W. Starostecki, Director
Division of Project and Resident Programs

cc w/encl:
A. V. Morisi, Manager, Nuclear Operations Support
R. D. Machon, Nuclear Operations Manager - Pilgrim Station
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
Commonwealth of Massachusetts (2)
NRC Resident Inspector

MAR 22 '00 11:11 PILGRIM NRC RESIDENT P.3

BOSTON Edison COMPANY

PILGRIM NUCLEAR POWER STATION
RFD #1 ROCKY HILL ROAD
PLYMOUTH, MASSACHUSETTS 02360

R. D. MACHON
NUCLEAR OPERATIONS MANAGER
PILGRIM STATION

July 9, 1982

BECo Ltr. #82-188

Ronald C. Haynes
Regional Administrator, Region I
U. S. Nuclear Regulatory Commission
631 Park Avenue
King of Prussia, PA 19406

Docket Number 50-293
License DPR-35

Dear Sir:

The attached Licensee Event Report 82-019/03L-0, "A" Standby Gas Treatment System", is hereby submitted in accordance with the requirements of Pilgrim Nuclear Power Station Technical Specification 6.9.B.2.b.

If there are any questions on this subject, please contact us.

Respectfully submitted,

R. D. Machon
Nuclear Operations Manager
Pilgrim Station

GGW:ep

Enclosure: LER 82-019/03L-0

cc: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Standard BECo LER Distribution

MAR 22 '88 11:12 PILGRIM NRC RESIDENT P14

LICENSEE EVENT REPORT

CONTROL BLOCK: | | | | | | | (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

01 | M A P P S -1 | (2) | 0 0 - 0 0 0 0 0 - 0 0 | (3) | 4 1 1 1 1 | (4) | | (5)
LICENSEE CODE — LICENSE NUMBER — LICENSE TYPE — CAT

CON'T 01 REPORT SOURCE | L | (6) | 0 5 0 - 0 2 9 3 | (7) | 0 6 1 1 8 2 | (8) | 0 7 0 9 8 2 | (9)
DOCKET NUMBER — EVENT DATE — REPORT DATE

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

02 | On June 11, 1982, the "A" Standby Gas Treatment System was declared inoperable

03 | based on low flow test data per procedure 8.7.2.6. criteria. The redundant

04 | system was tested satisfactorily to allow continued reactor operation as required

05 | by Technical Specifications 3.7.B.1.c. The "A" SGTS was returned to service within

06 | the allowable limits.

07 |

08 |

SYSTEM CODE	CAUSE CODE	CAUSE SUBCODE	COMPONENT CODE	COMP. SUBCODE	VALVE SUBCODE
09 S C (11)	X (12)	Z (13)	Z Z Z Z Z Z (14)	Z (15)	Z (16)

(17) LER/RO REPORT NUMBER

EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
8 2	—	0 1 9	/	0 3	L	—	0

ACTION TAKEN	FUTURE ACTION	EFFECT ON PLANT	SHUTDOWN METHOD	HOURS (22)	ATTACHMENT SUBMITTED	NPRD-4 FORM SUB.	PRIME COMP. SUPPLIER	COMPONENT MANUFACTURER
C (18)	F (19)	Z (20)	Z (21)	0 0 0 0 0	Y (23)	N (24)	A (25)	Z 9 9 9

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

10 | The cause has been determined to be clogged filters due to resin beads from the

11 | condensate demineralizer system vents migrating into the duct work of the SGTS

12 | The demineralizer system was tagged out and cleanup of SGTS started. Procedure

13 | changes and a temporary modification were made and a long-term fix to preclude recur-

14 | rence initiated. Please refer to the attached event description.

FACILITY STATUS	% POWER	OTHER STATUS (30)	METHOD OF DISCOVERY	DISCOVERY DESCRIPTION (32)
15 E (28)	0 7 5 (29)	NA	B (31)	Surveillance Test

ACTIVITY RELEASED	CONTENT OF RELEASE	AMOUNT OF ACTIVITY (35)	LOCATION OF RELEASE (36)
16 Z (33)	Z (34)	NA	NA

PERSONNEL EXPOSURES

NUMBER	TYPE	DESCRIPTION (39)
17 0 0 0 (37)	Z (38)	NA

PERSONNEL INJURIES

NUMBER	DESCRIPTION (41)
18 0 0 0 (40)	NA

LOSS OF OR DAMAGE TO FACILITY (43)

TYPE	DESCRIPTION
19 Z (42)	NA

PUBLICITY

ISSUED	DESCRIPTION (45)	NRC USE ONLY
20 N (44)	NA	

PILGRIM NUCLEAR POWER STATION
DOCKET NO. 50-293

Attachment to LER 82-019/031-0

On June 11, 1982 during steady state reactor operation, while conducting a surveillance test #8.7.2.6, of the Standby Gas Treatment System (SGTS), the 'A' SGTS train was declared inoperable due to the inability to attain sufficient flow as defined by the test criteria. The redundant system was then successfully tested as required by Technical Specifications 3.7.B.1.c and an investigation was conducted to determine cause.

The investigation determined the cause to be carryover of resin beads from the condensate demineralizer vent system, into the contaminated exhaust vent and to the SGTS. The resultant resin migration via the reactor building vent was reported to the NRC as a separate issue via the ENS line per 10 CFR 50.72.

The condensate demineralizer system was secured and cleanup and corrective measures initiated. Procedure changes and a temporary modification were made to allow interim operation, while for long term corrective actions, a new operating procedure and design change will be made.

This entire event is the subject of a report to be sent to NRC Region 1 as a reply to CAL #82-19. A synopsis of this report is as follows:

> Backwashing of demineralizer beds, by design, removes resin fines and particulates. It is expected that some whole resin beads will also be entrained.
>
> During initial startup operations, a gas scrubber was designed and installed to minimize this entrainment. Since the time the scrubber was installed, the system has suffered from component breakdown which resulted in resin being found in the radwaste and ventilation systems.
>
> In order to maintain condensate demineralizers operating within low differential values, so as to maintain maximum filter capabilities to minimize crud loading of the reactor vessel and attendant radiation exposures, numerous backwashes of the condensate demineralizer beds were required during the ascension to power subsequent to extended refuel outages. The resin beads that had accumulated in the vent ducting over the years were hastened in their migration by the repeated venting operations and by virtue of SGTS testing using a common ventilation plenum allowing the entrained resin beads to pass into the SGTS.
>
> The resin release outside the process buildings has been secured. Off-site sampling found no measurable amounts of resin released to the surrounding environs. Less than one-half of a cubic foot of resin beads was found inside the protected area fencing. Less than seventy cubic feet was found and removed from inside the ventilation system.

Special IR # 82-19
6/14 - 8/1

4. Followup of June 11, 1982 Identification of Spent Resin

The inspectors reviewed the licensee's actions with regard to the June 11, 1982 identification of spent resin on roof tops and pavements and the NRC Confirmatory Action Letter (CAL) No. 82-19 dated June 16, 1982. No further condensate demineralizer system backwash evolutions were performed until the licensee took actions to prevent recurrence. A temporary modification was made to the vent system by blanking off the outlet of the gas scrubber to the Contaminated Exhaust System. The licensee made use of the dump valve off of the gas scrubber to vent the demineralizers/cation/storage tanks to the Reactor Building equipment sump in the HPCI quadrant.

A trial run was made with clean resin and resulted in no further increase of resin into the ventilation system. Inspections were made of the ventilation system (dampers and plenums) and removal of any previously deposited resin was performed. Procedure changes were made to ensure that backwashing evolutions were compatible with the new vent path. The licensee also initiated actions to prepare the Ultrasonic Resin Cleaner (URC) for future use in an attempt to reduce the need for some future backwashing evolutions.

On June 22, 1982, at about 12:50 pm, (while touring the condensate demineralizer area of the Turbine Building as part of a review of procedure TP-82-44, Test Program for Developing an Alternate Venting Pathway for Condensate Demineralizers) the inspector noted the existence of a resin slurry on the floor near the condensate pumps.

The inspector determined that the spill of resin was caused by a failed check valve in the condensate transfer system and allowed clean and spent resin to exit an open flow meter at panel C127 which was being cleaned as part of the URC system maintenance. No violations of equipment control tagging or radiation protection procedures were identified.

The inspector noted the existence of an out of calibration (due April 10, 1982) survey meter in the area under a table. This meter was immediately removed from the area by the licensee, and the inspector verified, through a review of radiation survey records, that the out of calibration meter had not been used following the due date.

No violations were identified during this followup. The inspectors will continue to review condensate demineralizer operations during routine inspections of the facility.

MAR 22 '88 11:13 PILGRIM NRC RESIDENT P17

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-I-82-42

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region I staff on this date.

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
___ Notification of Unusual Event
___ Alert
___ Site Area Emergency
___ General Emergency
_X_ Not Applicable

Subject: RELEASE OF SPENT RESIN

At approximately 1300 on June 11, 1982 spent resin was found on the ground near the Turbine Building. Subsequent surveys identified contamination of the roofs of the Turbine, Reactor, Off-Gas and Re-Tube Buildings. Contamination was also found on the ground within the site controlled areas. Contamination levels ranged from 20-30,000 dpm/100 cm² with maximum contamination of up to 100,000 dpm/100 cm². Gamma isotopic analysis of the resin identified primarily long lived radionuclides (Co-60, Cs-137, Cs-134 and Mn-54).

No contamination was identified off-site or in storm drains. All personnel are being frisked prior to exiting the site and no personnel contamination has been identified.

The resin may have been released through the reactor building vent duct which exhausts to the atmosphere at an elevation of approximately 100 ft. The licensee has found approximately 10 ft³ of resin in the Standby Gas Treatment System inlet plenum. The source of the resin is being investigated. Three radiation specialists have been dispatched to the site to evaluate the radiological aspects of the occurrence.

Media interest is expected due to public interest in the facility. The licensee is considering issuing a press release. The NRC does not plan to issue a press release but will respond to media inquiries. The Commonwealth of Massachusetts has been informed.

This PN is current as of 4:45 P.M., June 11, 1982.

CONTACT: Elsasser 488-1235 Brunner 488-1225

DISTRIBUTION:

H. St.____	MNBB____	Phillips 5:28 6/11/82	E/W____ (FOR BROADCAST)	Willste____	Mail: ADM:DMB
Chairman Palladino	EDO	NRR	IE	NMSS	DOT:Trans
Comm. Gilinsky	PA		OIA	RES	
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PDR	Regional Offices ____				

TMI Resident Section 5:42 6/11/82
RI Resident Office 5:34 6/11/82

Licensee: ____
(Reactor Licensees)

8206170377 820611
PDR I&E
PNO-I-82-042 PDR

MAR 22 '88 11:14 PILGRIM NRC RESIDENT P18

[illegible]
[illegible]
[illegible] or evaluation, and is basically all that is [illegible]
this date

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
_____ Notification of [illegible]
_____ Alert
_____ Site Area Emergency
_____ General Emergency
_x_ Not Applicable

Subject: RELEASE OF SPENT RESIN (UPDATE PNO-I-82-42)

Surveys of the entire site within the protected area and surveys of selected areas of the licensee controlled area were made within 3 hours of the identification of the spent resin release. The licensee's onsite surveys identified two contaminated pavement areas which were barricaded and posted. Surveys confirmed contamination of the Turbine, Administration, Augmented Off-Gas and Re-Tube Building roofs. The Reactor Building Roof was found to be free of contamination. The licensee's offsite survey included surveys of cars, parking lots, shorefront, and security access areas. No contamination was identified. Routine environmental air samples covering the period June 1-15, 1982 were counted. Nothing unusual was identified. Because of the size and weight of the resins, no offsite airborne release of the beads appears to have occurred. This was confirmed by air samples collected during clean-up of the contaminated pavement areas which when counted indicated background and the identification of resins only on roof-tops under the Reactor Building Vent. Preliminary samples of storm drain residue have been counted with no contamination identified. All contaminated ventilation ducts have been vacuumed clean. A duct surveillance program has been established to identify any additional resin accumulation.

The licensee believes the resin entered the ventilation ducts from the condensate demineralizer system during resin backwashing via the Cation Regeneration Tank Vent. In addition, resin from defective condensate demineralizer vent valves may have also been released prior to their repair during the September 1981 -March 1982 refueling outage. The resin appears to have been released from the Reactor Building Ventilation Exhaust System via vents above the reactor building roof, prior to the repair of defective filters in this system in September 1981.

The licensee has suspended all transfer operations which could result in further resin releases to ventilation ducts and has initiated additional environmental sampling. The licensee's actions were monitored by three Region I Radiation Specialists throughout the weekend. Region I will issue a Confirmatory Action Letter to address planned licensee corrective actions. The licensee is continuing to review the source and cause to determine what permanent corrective action will be needed. The Resident Inspectors are closely following licensee actions concerning this event.

Media interest has occurred. The licensee has responded to media inquiries but does not plan to issue a press release. The NRC will respond to media inquiries but does not plan to issue a press release.

This PN is current as of 11:00 a.m., June 14, 1982.

[illegible]

Region I Form 83

SEP 25 1986

MEMORANDUM FOR: William F. Kane, Director, Division of Reactor Projects

THROUGH: Harry B. Kister, Chief, Reactor Projects Branch No. 1, DRP
Jack Strosnider, Chief, Reactor Projects Section No. 1B, DRP

FROM: Roy L. Fuhrmeister, Reactor Engineer, RPB No. 1, DRP

SUBJECT: PILGRIM RESIN RELEASE IN JUNE 1982

During recent public meetings in the vicinity of Plymouth, Massachusetts there have been numerous references to the resin release at Pilgrim in June of 1982. These references have most often been made by Mr. Abbott of the Plymouth County Nuclear Information Group in the manner of "the accident in 1982". A great deal has been made of the increased dose measured on a particular Thermo-Luminescent Dosimeter (TLD) during the summer and autumn of that year. In order to determine if there was any credence to the claims that the Pilgrim resin release contaminated the environment as far away as New Hampshire, a number of TLD data points were extracted from the NUREG 0837 series and plotted on a common time line. An explanation of the data points selected from random plants, a tabulation of the data, and a plot on the common time axis are attached.

It is interesting to note that during the first half of 1984, while the plant was shut down, TLD 1 from Pilgrim showed striking increases in the dose. Also of note is the fact the TLD 49 from Pilgrim, located in Weymouth, Massachusetts, shows a consistently higher dose than TLD 13, which is only 0.7 miles from the plant.

As a check on TLD 1, the plant operation time-line and quarterly release data are also included in the figure. No correlation with plant activities is readily apparent. In fact, the high reading in early 1984, with the plant shut down and no releases being made is inconsistent with Mr. Abbott's contentions.

In conclusion, it can be seen that the off-site dose in the vicinity of Pilgrim Nuclear Power Station followed the general trend of the other sites in the Northeastern United States. This trend includes a significant drop in doses during the first quarter of 1982. This drop, if narrowly construed, could lead one to the conclusion that the second quarter 1982 dose was significantly higher. This would be an erroneous conclusion, since second quarter 1982 dose is lower than the fourth quarter 1981 dose. In general, it appears that from mid-1981 to mid-1983, Eastern Massachusetts dose data followed the decreasing trend evidenced across the Northeast United States. In fact the doses in Eastern Massachusetts, including those measured around the Pilgrim site (with the exception of TLD No. 1 which is exposed to turbine "shine"), were on the order of 70% of expected natural background throughout the period. First quarter 1983 doses show a dramatic drop in Eastern Massachusetts, despite a major release from Pilgrim during that time period (13,200 ci, higher than the 1982 release). It is also worthy of note that with the exception of the third quarter 1981, Weymouth, Massachusetts doses

were higher than those recorded only 0.7 miles from the site. This suggests factors other than operation of and releases from Pilgrim are affecting the results of the environmental monitoring program. This also shows that the 1982 resin release and higher dose readings are strictly coincidental.

The dose readings on TLD 1 are in the range of 1 to 3 times the expected background levels for the area. The cause of the elevated readings was originally thought to be "turbine shine". The 1984 data do not support that conclusion, and further information on plant activities in 1984 is being developed. Particular interest is being paid to temporary on-site storage of materials removed during the recirculation piping changeout.

Attachment 6 shows typical expected doses.

Roy L. Fuhrmeister

Roy L. Fuhrmeister
Reactor Engineer, RPS 1B
DRP

Attachments:
1. Explanation of Data Points
2. Tabulation of Data
3. Plot of TLD Exposure Data 1981-1984
4. PNO-I-82-42
5. PNO-I-82-42a
6. Extract from Health Physics and Radiological Health Handbook

cc:
H. Kister
J. Strosnider
L. Doerflein
M. McBride

[illegible]

List of [illegible] Exposure Data for 1981 - 1984
Data extracted from NUREG 0837 Series

Stations used are identified as follows

ID	Unit	Azimuth	Distance	Location
1	Pilgrim	233°	0.09 mi	Pilgrim Overlook On-site
13	Pilgrim	146°	0.7 mi	Rocky Hill Road
49	Pilgrim	321°		Weymouth, [illegible]
[illegible]19	Vermont Yankee	[illegible]°	138 mi	Wilmington, Vermont
[illegible]1	[illegible]	[illegible]°	[illegible] mi	[illegible], Minnesota
[illegible]	[illegible]	[illegible]°	[illegible] mi	[illegible] State [illegible]

Stations 49, [illegible], [illegible]1, and [illegible] on basis of [illegible] location [illegible] of plant on environment in order to get an indication of regional and national trends

Station 1 was chosen as representative of turbine shine

Station 13 was chosen as representative of closest road to site

All data are normalized to a "standard quarter" of 90 days

* indicates data not available due to lost/damaged TLD

† indicates data not available due to report missing

Tabulation of [illegible]

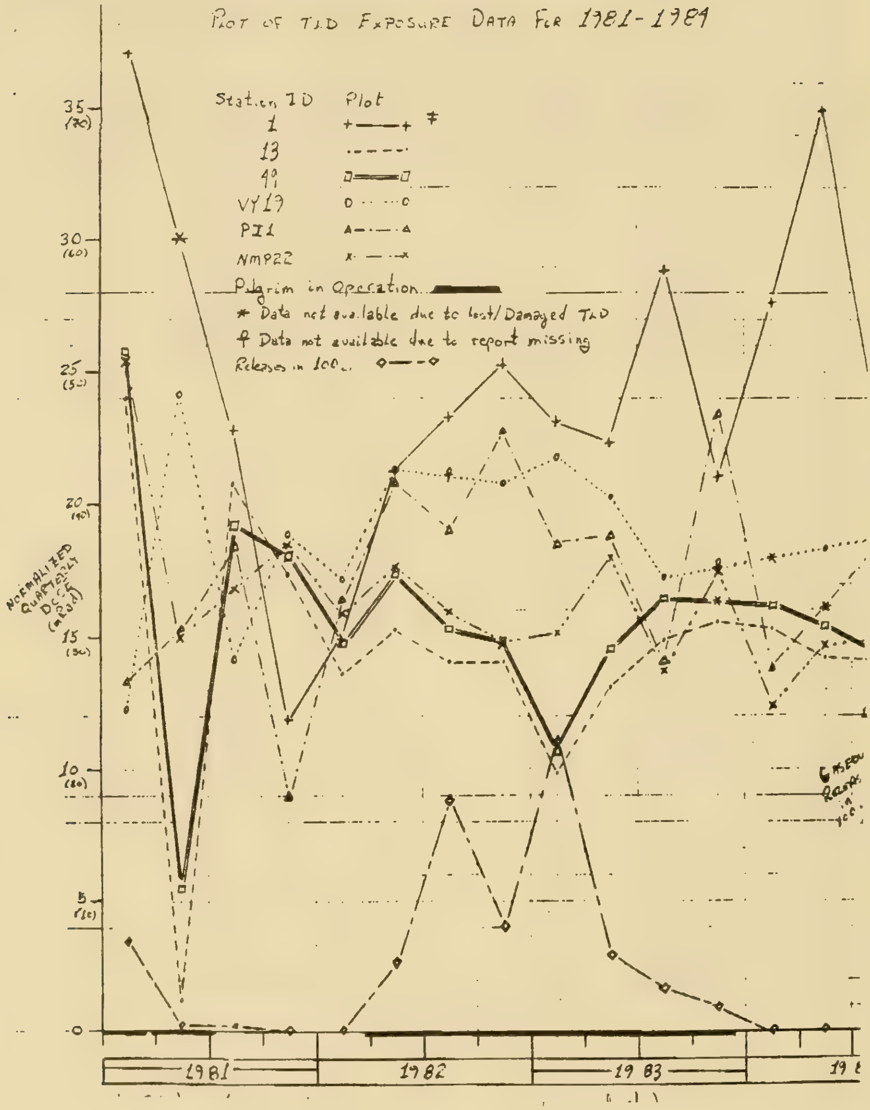
yr	qtr	station	mR/qtr	yr	qtr	station	mR/qtr
'81	1	1	24.1?	'82?	1	1	29.9?
		13	29.0?			13	13.6
		49	25.8?			49	19.9?
		WJ 19?	12.2			WJ 19?	17.1?
		Pd 1?	13.3			Pd 1?	16.4?
		RMP 22?	25.5			RMP 22?	15.9?
	2	1	*		2	1	43.5?
		13	1.2			13	15.[illegible]
		49	5.4			49	17.4
		WJ 19?	24.1?			WJ 19?	21.3
		Pd 1?	15.2			Pd 1?	20.9?
		RMP 22?	15.0			RMP 22?	15.6?
	3	1	45.5		3	1	46.4
		13	20.7			13	14.1?
		49	19.2			49	15.3?
		WJ 19?	14.1			WJ 19?	*
		Pd 1?	18.5			Pd 1?	19.0
		RMP 22?	16.7			RMP 22?	15.9
	4	1	23.5		4	1	50.4?
		13	17.4			13	14.1
		[illegible]	17.9?			49	14.8
		WJ 19?	18.9?			WJ 19?	20.9?
		Pd 1?	8.9?			Pd 1?	22.7?
		RMP 22?	18.5			RMP 22?	14.9

Attachment 2

yr	qtr	station	mR/std qtr
83	1	1	40.1
		13	9.8
		49	10.4
		OQ 19	21.7
		PL 1	18.5
		NM PZZ	15.3
	2	1	44.9
		13	13.1
		4[illegible]	14.5
		OQ 19	20.3
		PL 1	18.3
		NM PZZ	13.0
	3	1	57.7
		13	14.8
		49	16.4
		OQ 19	17.1
		PL 1	14.0
		NM PZZ	13.7
	4	1	42.1
		13	15.5
		49	*
		OQ 19	f
		PL 1	23.4
		NM PZZ	17.6

yr	qtr	station	mR/std qtr
8[illegible]	1	1	55.4
		13	15.[illegible]
		49	16.1
		OQ 19	*
		PL 1	15.3
		NM PZZ	15.[illegible]
	2	1	68.9
		13	14.[illegible]
		49	15.4
		OQ 19	13.[illegible]
		PL 1	*
		NM PZZ	[illegible]
	3	1	45.[illegible]
		13	14.1
		49	14.2
		OQ 19	*
		PL 1	18.6
		NM PZZ	14.8

MAR 22 '88 11:17 PILGRIM NRC RESIDENT P24



MAR 22 '88 11:18 PILGRIM NRC RESIDENT P25

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE

This preliminary notification constitutes EARLY notice of events of possible safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the staff.

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
____ Notification of Unusual Event
____ Alert
____ Site Area Emergency
____ General Emergency
__X__ Not Applicable

Subject: RELEASE OF SPENT RESIN

At approximately 1300 on June 11, 1982 spent resin was found on the ground near the Turbine Building. Subsequent surveys identified contamination of the roofs of the Turbine, Reactor, Off-Gas and Re-Tube Buildings. Contamination was also found on the ground within the site controlled areas. Contamination levels ranged from [illegible] dpm/100 cm² with maximum contamination of up to 100,000 dpm/100 cm². Gamma analysis of the resin identified primarily long lived radionuclides (Co-60, [illegible], Cs-134 and Mn-54).

No contamination was identified off-site or in storm drains. All personnel are being frisked prior to exiting the site and no personnel contamination has been [illegible].

The resin may have been released through the reactor building vent duct which exits to the atmosphere at an elevation of approximately 100 ft. The licensee has found approximately 10 ft³ of resin in the Standby Gas Treatment System inlet plenum. The source of the resin is being investigated. Three radiation specialists have been dispatched to the site to evaluate the radiological aspects of the occurrence.

Media interest is expected due to public interest in the facility. The licensee is considering issuing a press release. The NRC does not plan to issue a press release but will respond to media inquiries. The Commonwealth of Massachusetts has been informed.

This PN is current as of 4:45 P.M., June 11, 1982.

CONTACT: Elsasser 488-1235 Brunner 488-1225

DISTRIBUTION:

H. St. ____	MNBB ____	Phillips 5:38 6/11/82	E/W ____	Willste ____ Mail: [illegible]
Chairman Palladino	EDO	NRR	IE	NMSS
Comm. Gilinsky	PA		OIA	RES
Comm. Ahearne	MPA		AEOD	
Comm. Roberts	ELD			
ACRS		Air Rights	INPO	
SECY		SP	NSAC	
CA				
PDR	Regional Offices		[illegible] 5:42 6/11/82	

Regional [illegible]
PDR [illegible]
PNO-I-82-[illegible]

DCS No. 0293-820611
Date: June 14, 1982

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-I-82-42A

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region I staff on this date.

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
____ Notification of Unusual Event
____ Alert
____ Site Area Emergency
____ General Emergency
x Not Applicable

Subject: RELEASE OF SPENT RESIN (UPDATE PNO-I-82-42)

Surveys of the entire site within the protected area and surveys of selected areas of the licensee controlled area were made within 3 hours of the identification of the spent resin release. The licensee's onsite surveys identified two contaminated pavement areas which were barricaded and posted. Surveys confirmed contamination of the Turbine, Administration Augmented Off-Gas and Re-Tube Building roofs. The Reactor Building Roof was found to be free of contamination. The licensee's offsite survey included surveys of cars, parking lots, shorefront, and security access areas. No contamination was identified. Routine environmental air samples covering the period June 1-15, 1982 were counted. Nothing unusual was identified. Because of the size and weight of the resins, no offsite airborne release of the beads appears to have occurred. This was confirmed by air samples collected during clean-up of the contaminated pavement areas which when counted indicated background and the identification of resins only on roof-tops under the Reactor Buiding Vent. Prelimin ary samples of storm drain residue have been counted with no contamination identified. All contaminated ventilation ducts have been vacuumed clean. A duct surveillance program has been established to identify any additional resin accumulation.

The licensee believes the resin entered the ventilation ducts from the condensate demineralizer system during resin backwashing via the Cation Regeneration Tank Vent. In addition, resin from defective condensate demineralizer vent valves may have also been released prior to their repair during the September 1981 -March 1982 refueling outage. The resin appears to have been released from the Reactor Building Ventilation Exhaust System which vents above the reactor building roof, prior to the repair of defective filters in this system in September 1981.

The licensee has suspended all transfer operations which could result in further resin releases to ventilation ducts and has initiated additional environmental sampling. The licensee's actions were monitored by three Region I Radiation Specialists throughout the weekend. Region I will issue a Confirmatory Action Letter to address planned licensee corrective actions. The licensee is continuing to review the source and cause to determine what permanent corrective action will be needed. The Resident Inspectors are closely following licensee actions concerning this event.

Media interest has occurred. The licensee has responded to media inquiries but does not plan to issue a press release. The NRC will respond to media inquiries but does not plan to issue a press release.

This PN is current as of 11:00 a.m., June 14, 1982.

Region I Form 83
(Rev. March, 1982)

IE34

The Health Physics and Radiological Health Handbook

Compiled and Edited by
Bernard Shleien, Pharm. D., Certified Health Physicist, ABHP and
Michael S. Terpilak, Certified Health Physicist, ABHP

Nucleon Lectern Associates

Table 1.5. Summary of average annual per capita doses to whole U.S. population

Source	Ave. per capita dose (mrem/year)	
Natural background		
Cosmic	31	
Terrestrial	68	
Tech. inhanced	4	
Sub-total		103
Man-made		
Medical		
X-ray	77	
Nuc. Med.	14	
Sub-total		91
Nuclear weapons	4-5	
Nuclear power	< 1	
Consumer products	0.5-1.5	
Sub-total		~ 8
Total		~ 200

Table 1.6. U.S. general population collective dose estimates - 1978

(From Biologic Effects of Ionizing Radiation. Report of the Science Work Group of the Interagency Task Force on Radiation, Department of Health, Education and Welfare, June, 1979)

Source	Person-rems per year (in thousands)
Natural background	20,000
Technologically enhanced	1,000
Healing arts	18,000
Nuclear weapons	
Fallout	1,000-1,600
Weapons development, testing and production	0.165
Nuclear power	56
Consumer products	6

Table 1.7. Annual per capita dose from natural radioactivity

Source	Variability	Dose[b] (mrem/year)
Cosmic	Average[a]	31
	Rock mountain states	60 > 80
	Jet flight - trans continental	2.5/Trip
Terrestrial (external)	Average[a]	40
	Colorado	75-140
(internal)	Average[a] (gonads)	28
	Lung	100-450
Tech. inhanced	Average[a]	4
Total		103

[a]Average whole-body dose to the whole population.

[b]Uncorrected for shielding of structures (reduce cosmic by 10% and terrestrial by 20%). Self-shielding by body further reduces dose.

Table 1.8. Radiation doses from medical radiation[a]

Source	Mean active bone-marrow dose		
		mrem/exam	Ave. per capita dose[b] (mrem/year)
Diagnostic x-rays			
Chest x-ray		10	
Upper GI		500	
Lower GI		900	
Skull		80	
Full mouth (dental)		9	
Sub-total			77[c]
Radio pharmaceuticals	Dose (mrem) to organ Specified/exam		
I^{133} (function)	Thyroid	5000	
	Whole body	30	
Tc^{99M}	Whole body	180	
Xe^{133}	Whole body	5	
	Whole-body equivalent to whole population	14	
Total			91

[a]Doesn't include therapy

[b]Based on whole population (exposed and unexposed)

[c]GSD is 20 mrem/year (GSD is the Genetically Scientific Dose)

ENCLOSURE 4
TO QUESTION 7

NUREG-0837
Vol. 2, No. 3

NRC TLD Direct Radiation Monitoring Network

Progress Report
July-September 1982

U.S. Nuclear Regulatory Commission

NRC Region I

F. Costello, T. Thompson, L. Cohen

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 820630-821008 101 DAYS
FIELD TIME 820707-821005 91 DAYS

NRC STATION	LOCATION AZIMUTH/DIST (deg.)	(mi.)	GROSS EXPOSURE(mR) +- Std. Dev.	EXPOSURE RATE mR/Std.Qtr. +- Std. Dev.
001	288	0.10	52.1 +- 1.3	46.4 +- 1.1
002	310	0.20	19.6 +- 1.1	17.5 +- .9
005	289	0.70	19.4 +- .2	17.3 +- .2
006	261	1.70	17.9 +- .9	15.9 +- .8
007	270	0.50	19.4 +- .0	17.3 +- .0
008	247	0.30	19.2 +- .3	17.1 +- .3
009	224	0.30	17.6 +- .3	15.7 +- .2
010	205	0.30	27.1 +- 1.2	24.1 +- 1.1
011	184	0.03	22.2 +- .3	19.8 +- .2
012	159	0.40	23.2 +- .5	20.6 +- .4
013	146	0.70	15.8 +- .5	14.1 +- .4
014	155	1.00	17.4 +- .0	15.5 +- .0
016	136	1.30	20.3 +- .2	18.1 +- .2
018	212	0.80	19.7 +- .0	17.6 +- .0
019	232	1.00	14.6 +- .3	13.0 +- .3
021	256	1.60	16.8 +- .1	15.0 +- .1
022	130	2.50	15.4 +- .5	13.7 +- .5
023	146	3.40	15.3 +- .8	13.6 +- .7
025	168	1.50	15.6 +- .3	13.9 +- .2
026	180	1.30	14.9 +- .2	13.3 +- .2

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 820630-821008 101 DAYS
FIELD TIME 820707-821005 91 DAYS

NRC STATION	LOCATION AZIMUTH/DIST (deg.)	(mi.)	GROSS EXPOSURE(mR) +- Std. Dev.	EXPOSURE RATE mR/Std.Qtr. +- Std. Dev.
027	231	1.80 .	16.3 +- .7	14.5 +- .7
030	153	2.20	17.1 +- .1	15.2 +- .1
031	179	2.50	15.2 +- .0	13.5 +- .0
032	217	2.60	13.9 +- .4	12.4 +- .4
033	234	2.50	16.0 +- .2	14.2 +- .1
037	264	4.20	17.9 +- .1	15.9 +- .1
039	155	5.30	13.3 +- .2	11.9 +- .2
040	272	4.60	16.2 +- .1	14.5 +- .1
043	291	5.80	18.2 +- .6	16.2 +- .5
045	-	-	13.9 +- .0	12.3 +- .0
047	301	26.2	18.0 +- .0	16.0 +- .0
048	301	26.2	17.7 +- .2	15.8 +- .1
049	301	26.2	17.2 +- .1	15.3 +- .1

COMMENTS:

STATION 1 IS ON LICENSEE PROPERTY (PILGRIM OVERLOOK AREA).
ACCESS IS CONTROLLED

PILGRIM
FOR THE PERIOD 820630-821008 101 DAYS

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING

AZIMUTH (deg.)	AVER. EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
348.75-11.25 (N)	NO DATA+-NO DATA	0
11.25-33.75 (NNE)	NO DATA+-NO DATA	0
33.75-56.25 (NE)	NO DATA+-NO DATA	0
56.25-78.75 (ENE)	NO DATA+-NO DATA	0
78.75-101.25 (E)	NO DATA+-NO DATA	0
101.25-123.75(ESE)	NO DATA+-NO DATA	0
123.75-146.25(SE)	14.9 +- 2.2	4
146.25-168.75(SSE)	15.4 +- 3.3	5
168.75-191.25(S)	15.5 +- 3.7	3
191.25-213.75(SSW)	20.9 +- 4.7	2
213.75-236.25(SW)	14.0 +- 1.3	5
236.25-258.75(WSW)	16.0 +- 1.5	2
258.75-281.25(W)	15.9 +- 1.2	4
281.25-303.75(WNW)	26.7 +- 17.1	3
303.75-326.25(NW)	17.5 +- 0.0	1
326.25-348.75(NNW)	NO DATA+-NO DATA	0

DISTANCE(mi) FROM THE REACTOR	AVER.EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
0-2	18.3 +- 7.4	19
2-5	14.1 +- 1.1	8
>5	14.1 +- 3.1	2
UPWIND CONTROL DATA	15.7 +- .3	3

NUREG-0837
Vol. 2, No. 1

NRC TLD Direct Radiation Monitoring Network

Progress Report
January - March 1982

U.S. Nuclear Regulatory Commission

F. Costello, T. Thompson, L. Cohen

PILGRIM
FOR THE PERIOD 811222-820415 115 DAYS

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING

AZIMUTH (deg.)	AVER. EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
348.75-11.25 (N)	0.0 +- 0.0	0
11.25-33.75 (NNE)	0.0 +- 0.0	0
33.75-56.25 (NE)	0.0 +- 0.0	0
56.25-78.75 (ENE)	0.0 +- 0.0	0
78.75-101.25 (E)	0.0 +- 0.0	0
101.25-123.75(ESE	0.0 +- 0.0	0
123.75-146.25(SE)	15.3 +- 2.3	4
146.25-168.75(SSE)	16.3 +- 2.9	6
168.75-191.25(S)	14.9 +- 1.3	3
191.25-213.75(SSW)	18.8 +- .9	2
213.75-236.25(SW)	13.8 +- .7	5
236.25-258.75(WSW)	15.9 +- .6	2
258.75-281.25(W)	15.8 +- 1.3	5
281.25-303.75(WNW)	18.0 +- 5.9	6
303.75-326.25(NW)	16.8 +- 0.0	1
326.25-348.75(NNW)	0.0 +- 0.0	0

DISTANCE(mi) FROM THE REACTOR	AVER.EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
0-2	16.9 +- 3.7	19
2-5	15.0 +- 1.6	10
>5	14.7 +- 1.4	5

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 811221-820415 115 DAYS
FIELD TIME 820105-820406 92 DAYS

NRC STATION	LOCATION AZIMUTH (deg.)	DIST (mi.)	INTEGRATED EXPOSURE (mR) +- Std. Dev.	EXPOSURE RR mR Std.Qtr. +- Std. Dev.
027	231	1.30	18.2 +- .3	14.3 +- .3
030	153	2.20	20.5 +- .5	16.1 +- .4
031	179	2.50	17.8 +- .1	13.9 +- .1
032	217	2.60	16.8 +- .1	13.1 +- .1
033	234	2.50	17.8 +- .3	14.0 +- .2
037	264	4.20	20.1 +- .0	15.7 +- .0
038	152	3.50	24.1 +- .3	18.9 +- .2
039	155	5.30	16.3 +- .1	12.8 +- .1
040	272	4.60	18.5 +- .6	14.5 +- .5
042	281	4.60	18.8 +- .6	14.7 +- .5
043	291	5.80	21.0 +- .1	16.4 +- .1
045	-	-	15.9 +- .4	12.4 +- .3
047	301	26.2	17.8 +- .0	13.9 +- .0
048	301	26.2	19.9 +- .4	15.6 +- .3
049	301	26.2	19.0 +- .7	14.9 +- .6
050	CTL	TLD	17.1 +- .0	13.3 +- .0

COMMENTS:

STATION I IS ON LICENSEE PROPERTY (PILGRIM OVERLOOK AREA).
ACCESS IS CONTROLLED

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 811222-820415 115 DAYS
FIELD TIME 820105-820406 92 DAYS

NRC STATION	LOCATION AZIMUTH (deg.)	DIST (mi.)	INTEGRATED EXPOSURE (mR) +- Std. Dev.	EXPOSURE RATE mR Std.Qtr +- Std. De
001	288	0.10	38.2 +- .8	29.9 +- .6
002	310	0.20	21.5 +- .7	16.8 +- .6
005	289	0.70	21.9 +- .3	17.2 +- .2
006	261	1.70	20.6 +- .1	16.1 +- .1
007	270	0.50	22.7 +- .4	17.7 +- .3
008	247	0.30	20.9 +- .2	16.4 +- .1
009	224	0.30	18.9 +- .1	14.8 +- .1
010	205	0.30	24.8 +- .0	19.4 +- .0
011	184	0.03	21.0 +- .1	16.4 +- .1
012	159	0.40	26.1 +- .4	20.4 +- .3
013	146	0.70	17.3 +- .2	13.6 +- .2
014	155	1.00	19.8 +- .5	15.5 +- .4
016	136	1.30	23.8 +- .0	18.6 +- .0
018	212	0.80	23.2 +- 1.0	18.1 +- .8
019	232	1.00	16.6 +- .3	13.0 +- .3
021	256	1.60	19.8 +- .1	15.5 +- .1
022	130	2.50	19.1 +- .0	14.9 +- .0
023	146	3.40	17.8 +- .6	13.9 +- .5
025	168	1.50	17.8 +- .6	13.9 +- .4
026	180	1.30	18.3 +- .3	14.3 +- .3

Updated Copy

NUREG-0837
Vol. 2, No. 2

NRC TLD Direct Radiation Monitoring Network

Progress Report
April-June 1982

U.S. Nuclear Regulatory Commission

NRC Region I

F. Costello, T. Thompson, L. Cohen

PILGRIM
FOR THE PERIOD 820325-820712 110 DAYS

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING

AZIMUTH (deg.)	AVER. EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
348.75-11.25 (N)	0.0 +- 0.0	0
11.25-33.75 (NNE)	0.0 +- 0.0	0
33.75-56.25 (NE)	0.0 +- 0.0	0
56.25-78.75 (ENE)	0.0 +- 0.0	0
78.75-101.25 (E)	0.0 +- 0.0	0
101.25-123.75(ESE)	0.0 +- 0.0	0
123.75-146.25(SE)	16.0 +- 1.1	4
146.25-168.75(SSE)	17.9 +- 4.0	5
168.75-191.25(S)	18.4 +- 5.8	3
191.25-213.75(SSW)	18.9 +- 2.9	2
213.75-236.25(SW)	16.6 +- 2.2	5
236.25-258.75(WSW)	17.3 +- 1.4	2
258.75-281.25(W)	17.9 +- 3.4	5
281.25-303.75(WNW)	26.5 +- 13.8	3
303.75-326.25(NW)	18.0 +- 0.0	1
326.25-348.75(NNW)	0.0 +- 0.0	0

DISTANCE(mi) FROM THE REACTOR	AVER. EXPOSURE +- Std.Dev. (mR/Std.Qtr.)	# IN GROUP
0-2	19.5 +- 6.4	19
2-5	16.4 +- 1.6	9
>5	16.3 +- 3.3	2
UPWIND CONTROL DATA	17.0 +- .4	3

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 820325-820712 110 DAYS
FIELD TIME 820406-820707 93 DAYS

NRC STATION	LOCATION AZIMUTH (deg.)	DIST (mi.)	GROSS EXPOSURE(mR) +- Std. Dev.	EXPOSURE RATE mR Std.Qtr. +- Std. Dev.
026	180	1.30	18.2 +- .5	14.9 +- .4
027	231	1.80	19.4 +- .3	15.9 +- .3
031	179	2.50	18.7 +- .2	15.3 +- .2
032	217	2.60	24.5 +- .1	20.0 +- .1
033	234	2.50	18.9 +- .6	15.5 +- .5
037	264	4.20	21.3 +- .5	17.4 +- .4
038	152	3.50	19.1 +- .5	15.6 +- .4
039	155	5.30	17.0 +- .1	13.9 +- .1
040	272	4.60	19.8 +- .3	16.2 +- .3
042	281	4.60	18.4 +- .4	15.1 +- .3
043	291	5.80	22.7 +- .2	18.6 +- .2
047	301	26.2	20.3 +- .1	16.6 +- .1
048	301	26.2	20.9 +- .5	17.1 +- .4
049	301	26.2	21.3 +- .4	17.4 +- .3

COMMENTS:

STATION 1 IS ON LICENSEE PROPERTY (PILGRIM OVERLOOK AREA).
ACCESS IS CONTROLLED

PILGRIM

TLD DIRECT RADIATION ENVIRONMENTAL MONITORING
FOR THE PERIOD 820325-820712 110 DAYS
FIELD TIME 820406-820707 93 DAYS

NRC STATION	LOCATION AZIMUTH (deg.)	DIST (mi.)	GROSS EXPOSURE (mR) +- Std. Dev.	EXPOSURE RATE mR Std.Qtr. +- Std. Dev.
001	288	0.10	51.9 +- .5	42.5 +- .4
002	310	0.20	22.0 +- .1	18.0 +- .1
005	289	0.70	22.5 +- .6	18.4 +- .5
006	261	1.70	21.0 +- .1	17.1 +- .1
007	270	0.50	29.0 +- .3	23.8 +- .2
008	247	0.30	22.4 +- .0	18.3 +- .0
009	224	0.30	21.0 +- .6	17.2 +- .5
010	205	0.30	25.7 +- .4	21.0 +- .3
011	184	0.03	30.7 +- .9	25.1 +- .7
012	159	0.40	28.1 +- .2	23.0 +- .2
013	146	0.70	18.6 +- .3	15.2 +- .2
014	155	1.00	26.1 +- .0	21.4 +- .0
016	136	1.30	20.0 +- .4	16.4 +- .3
018	212	0.80	20.6 +- .2	16.9 +- .1
019	232	1.00	17.5 +- 1.1	14.4 +- .9
021	256	1.60	19.9 +- .3	16.3 +- .2
022	130	2.50	8.4 +- .2	15.1 +- .2
023	146	3.40	21.2 +- .1	17.3 +- .1
025	168	1.50	19.1 +- .1	15.6 +- .0

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE 5
TO QUESTION 7

Docket No. 50-293

JUL 8 1982

MEMORANDUM FOR: H. R. Denton, Director, ONRR

FROM: R. J. Mattson, Director, DSI/ONRR

SUBJECT: GENERIC IMPLICATIONS OF THE RELEASE OF SPENT DEMINERALIZER RESINS FROM PILGRIM, UNIT NO. 1

Reference: PNO-I-82-42/42A

The release of radioactive spent resins from the Pilgrim Power Station, reported in PNO-I-82-42, June 11, 1982, has been reviewed for generic implications in accordance with your request. Based on information in the PN and its update of June 14, 1982, on information in the docket file, and on information obtained in telephone discussions with Region I representatives, a licensee representative, and the Operating Project Manager (DL), it is our conclusion that there are several related factors in this incident which have both generic and licensee - specific implications. These are discussed in items (1) through (5) below.

(1) It is probable that the resins observed and reported in the PN originally escaped from operations involved in a resin cleaning operation for condensate demineralizer resins. Resins were apparently forced up a vent pipe into a ventilation exhaust duct, from which the resins were transported by ventilation air flow. Vent pipes are designed to maintain tank pressure close to atmospheric as tank levels fluctuate and gases evolve from tank contents. Such a design provides a controlled exhaust system rather than a discharge into the building atmosphere; many such vents are present in plant designs. While it is considered good design practice to install screens or filters in such vent lines, there were apparently no such devices in the Pilgrim vents. The Standard Review Plans 11.2 (Liquid Waste Management Systems) and 11.3 (Gaseous Waste Management Systems) and Regulatory Guide 1.143 (Radwaste System Design Guidance) do not specifically address such a design criterion.

(2) It is probable that water entered the ventilation exhaust ducts along with the resins noted in (1), above. While it is not known if this water was significantly radioactive, the presence of the water may have been a factor in the deterioration of filters and filter frames (see (3), below). Vent lines serving liquid systems should be designed to incorporate a device or mechanism, such as a water trap, to prevent the flow of liquids into vent pipes discharging to ventilation exhaust ducts. Neither the applicable Standard Review Plans nor the applicable Regulatory Guide address such a design feature.

(3) The licensee considers the most probable source of the discharge of radioactively contaminated resins to the roof and ground areas of the plant to be the reactor building ventilation exhaust duct. Based on the dispersal pattern of the resins, we arrived at the same conclusion. As noted in (1) and (2), above, resins are presumed to have entered tank vent pipes leading to ventilation ducts, probably in the form of a slurry. The continuous flow of warm dry air would cause the resin to dry out, leaving a residue of small beads or particles of low density, which can be carried along the duct by the ventilation exhaust air current. In the filtration plenum, air from the ventilation exhaust ducts is passed first through a fiberglass prefilter media and then through a HEPA (High Efficiency Particulate Air) filter. Air flow through the filters is horizontal and there is about a four-foot space (measured horizontally) between the prefilter banks and HEPA filter banks. Linear face flow velocity (design) of the prefilters is about 250 linear feet per minute, or about 3 mph. Each HEPA filter module has a dimensional cross-section of about 4 ft^2 and has a rated capacity, when new, of 1,000 cfm at a 1" (water) pressure drop; the face velocity for a HEPA filter is also about 250 linear feet per minute or about 3 mph.

An IE Health Physics appraisal team visited Pilgrim in January and February, 1980. The team's report, dated July, 1980, noted that the prefilters were "disintegrating in place" (Section 4.2.3.2, page 55) but that no damage to the HEPA filters could be observed by visual inspection. This situation was apparently not corrected until the refueling outage which began in September, 1981. In fairness to the licensee, though, it should be noted that the prefilter disintegration was not included as a "significant finding" by the NRC in the appraisal. While there may be extenuating circumstances which are not apparent from the IE appraisal, there appear to be no reasons why these non ESF systems could not have been taken out of service for replacement or repair in a more expeditious manner.

While we have not been able to determine the exact condition of the HEPA filters at the time of their replacement in September, 1981, licensee representatives did state many of the HEPA filters were found to be damaged. It should be pointed out that no release of resins had been identified at that time and no tests were performed to determine the nature or extent of leakage or damage. The staff considers that the Pilgrim occurrence has no direct implications as to the integrity of adequately tested and maintained HEPA filters in ESF filter systems but, rather, emphasizes the need for regular testing and surveillance where a specified level of performance is to be achieved and maintained. The occurence is, however, a clear demonstration that plant operators cannot neglect HEPA filter systems indefinitely and then expect them to perform as designed.

We note, however, that in the present regulatory climate, licensees, in general, have no compelling motivation to perform surveillance which is not formally required of them, especially when inoperability of a system will not lead to noncompliance. The fact that deteriorating prefilters were observed during the Pilgrim Health Physics appraisal and that radioactive resins were found to be present in the ventilation exhaust ducts was not evidence that Technical Specification release limits or Appendix I criteria were being exceeded and, therefore, there was no violation of regulatory requirements to initiate corrective action. The periodic testing, or replacement of non-ESF filtration system components represents an expenditure of money and manpower with little tangible benefit when only routine normal operation is considered; in an era of tight money and budgetary restraints, plant managers may be hard-pressed to justify to upper levels of utility management the expenditure of even a few thousands of dollars at a very high cost-benefit ratio.

(4) Technical Specifications require periodic testing of ESF filter systems at nearly all plants, as well as surveillance of parameters such as pressure drop, which are indicative of system condition and performance. Normal ventilation exhaust air filter systems are not ESF systems and, therefore, are not subject to Technical Specification requirements for testing and surveillance. Non-ESF ventilation exhaust filter systems are installed in nuclear power plant buildings to reduce releases of airborne material to levels that satisfy the criteria of Appendix I to 10 CFR Part 50; Pilgrim, Unit 1, is only one of many plants which do not regularly inspect, check, or test their non-ESF filter systems.

While the failure or procrastination on the part of operating plants to regularly test and assure the proper functioning of these systems may be interpreted by some parties as failing to provide maximum protection to the environment, making such testing a firm commitment would necessitate a substantial revision in the basic NRC philosophy of plant safety and environmental protection. Commitments made by applicants in their FSAR to Regulatory Guide 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," is the method currently used by NRR to implement design guidance and testing programs for non-ESF filter systems. Such criteria had not been established by the NRC when Pilgrim 1 was licensed in 1972, so it is likely that no commitment was ever made by Boston Edison to provide surveillance testing of the non-ESF filters at Pilgrim 1.

(5) The Licensee and IE (reference IE Health Physics Appraisal Report for Pilgrim, dated June 22, 1980, page 54) have been aware for over two years that radioactive resin beads and fines were present in Pilgrim ventilation exhaust ducts. The same appraisal report, page 55 notes serious deficiencies in the condition of ventilation exhaust prefilters and the presence of approximately six inches of spilled radioactive (2R/hr) resins on the floor of a room in the Radwaste Building (p. 48), as well as loose contamination up to 90 mrads/hr on the floor immediately outside that room. In view of the unique and highly visible nature of resin beads, the rather high radioactive contamination levels associated with the resin, and the knowledge that resins had been a problem in several areas of the plant for over two years, the Licensee's statement (PN Update June 14, 1982) that the resins had probably been released prior to September 1981 seems to indicate, at best, an absence of recognition of potential problems on the part of plant management. To admit that external plant contamination of this order of magnitude had gone unnoticed and undetected for over eight months would seem to admit to the existence of inadequacies in the Health Physics program.

IE COORDINATION

Our review has been coordinated with IE personnel at Bethesda, Region I, and the Resident Inspectors' office. The Radiological Safety Branch (IE) is currently reviewing completed Health Physics appraisal reports for other plants to identify any similar circumstances to confirm the generic nature of the Pilgrim incident and support the need for issuance o

guidance to licensees; this review has not been completed but will be made available at a later date.

SUMMARY

As the result of our review of the Pilgrim, Unit 1, PNO of June 11, 1982 (PNO-I-82-42), the staff suggests the following:

(1) As a short-term action, recommend to IE that an information notice be issued to all operating reactors which (a) describes the Pilgrim 1 resin dispersal event, (b) requests plants to voluntarily institute a surveillance program for existing non-ESF filtration systems if one does not exist and (c) requests that tank vent designs be reviewed and that, if appropriate and feasible, modifications be made to prevent inadvertent release of resins or liquids to the ventilation system. NRR staff is available to provide assistance to IE in the preparation of such a circular.

(2) As a longer term action, revise Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components installed in Light-Water-Cooled Nuclear Power Plants," and Standard Review Plan 11.2, "Liquid Waste Management Systems," to include design guidance and acceptance criteria which address (a) the incorporation of filters or screens in the design of vents from tanks which may contain resins, and (b) the incorporation of provisions into the vent design such as filters traps or check valves to prevent or minimize the flow of liquids through vent lines while permitting pressure equalization within the tank.

Roger J Mattson

R. J. Mattson, Director
Division of Systems Integration
Office of Nuclear Reactor Regulation

JUL 8 1982

cc: E. Case
D. Eisenhut
S. Hanauer
G. Laines
T. Novak
W. Houston
W. Gammill
D. Vassallo
F. Congel
L. Hulman
R. Bangart
C. Willis
R. Capra
L. Cunningham
K. Eccleston
P. Stoddart

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 1 9 1983

ENCLOSURE 6
TO QUESTION 7

AEOD/T307

MEMORANDUM FOR: Karl V. Seyfrit, Chief
Reactor Operations Analysis Branch
Office for Analysis and Evaluation
of Operational Data

THRU: Stuart D. Rubin, Lead Engineer
Reactor Systems 4
Reactor Operations Analysis Branch

FROM: John L. Pellet
Reactor Systems 4
Reactor Operations Analysis Branch

SUBJECT: TECHNICAL REVIEW REPORT ON PILGRIM 1 RESIN MIGRATION

Enclosed find the technical review report titled "Condensate Demineralizer Resin Migration Through the Plant Vent and Standby Gas Treatment System." This report concludes that no additional AEOD/ROAB involvement is necessary for this event.

John L. Pellet

John L. Pellet
Reactor Systems 4
Reactor Operations Analysis Branch

AEOD TECHNICAL REVIEW REPORT*

UNIT: Pilgrim 1
DOCKET: 50-293
LICENSEE: Boston Edison Company
NSSS/AE: General Electric/Bechtel

TR REPORT NO.: AEOD/T307
DATE: April 19, 1983
EVALUATOR/CONTACT: J. Pellet

SUBJECT: CONDENSATE DEMINERALIZER RESIN MIGRATION THROUGH THE PLANT VENT AND THE STANDBY GAS TREATMENT SYSTEM

EVENT DATE: June 11, 1982

SUMMARY

This report reviews the safety significance of the June 1982 discovery at Pilgrim that demineralizer resins had migrated throughout the plant contaminated exhaust vent to external plant areas inside the protected area fencing. Also, sufficient resin had migrated through the reactor building ventilation system to block proper operation of the Standby Gas Treatment System (SBGTS). References are cited which show that resin migration into the ventilation system and SBGTS had occurred at least three years previously. This report finds that the event was of minimal safety significance and concludes that current NRC efforts are adequate without additional AEOD involvement.

DISCUSSION

Plant & Status

Pilgrim 1 was in steady state power operation on June 11, 1982 while performing a surveillance instruction (SI) on the SBGTS.

Occurrence-Cause & Effect[1]

The SBGTS failed its routine SI due to low flow. The low flow was caused by carryover of resin beads from the condensate demineralizer vent piping to the reactor building ventilation system and contaminated exhaust vent and from there to the SBGTS. This carryover occurred during backwashing of the demineralizer. Backwashing with air and water resulted in resin fines, particulates, and some resin beads being entrained in the air/water backwash. An air scrubber was installed during initial startup to prevent resin migration into the ventilation system. However, it did not perform as expected since installation. As a result, substantial resin migrated to the radwaste and ventilation systems over a considerable time period.

After this event, contaminated resin beads were discovered outside of the plant buildings (but not offsite) as well as inside the vent system. Less than 70 cubic feet of resin was removed from the ventilation system and less than 1/2 of a cubic foot was found inside the protected area. Root cause of the substantial resin migration appears to be inadequate design of the scrubber intended to preclude such migration.

*This document supports ongoing AEOD and NRC activities and does not represent the position or requirements of the responsible NRC program office.

History

At least two cases of resin intrusion into the SBGTS have been previously reported[2,3] since June, 1979. This indicates that resin intrusion into the ventilation system and SBGTS has been a recognized problem at Pilgrim for several years without adequate resolution. However, prior to the June 11, 1982 event there was no evidence of contamination outside of the plant buildings.

Consequences

The consequences of this event may be broken down into three categories: 1) offsite release, 2) personnel exposure, and (3) system performance or availability. The resin migration problem produced no evidence of offsite release during this review. However, the resin migration clearly has resulted in added equipment contamination and substantial cleanup efforts by plant personnel over a period of several years, but this review found no indication of unacceptable personnel exposure. From a system viewpoint, this event demonstrates the potential for failure in a nonsafety system to act as a common cause initiator affecting multiple trains of a safety system (in this case SBGTS). This potential is mitigated because failure is as a result of flow restriction due to resin buildup and is therefore very slow with respect to the test interval (i.e., only two failures over the last three years). Also, even though one train of SBGTS was inoperable due to low air flow, the train was capable of performing at a reduced level. In summary, the resin migration produced minimal actual consequences in the three areas of concern.

Corrective Actions

The licensee actions to preclude further resin migration into the vent system may be divided into short-term and long-term efforts. The immediate actions by the licensee to remove existing resin and preclude additional migration were set out in Confirmative Action Letter No. 82-19[4]. Additionally, the licensee disconnected the ventilation system from the poorly functioning gas scrubber and rerouted the scrubber discharge (liquid, air, and resin) to the Reactor Building Equipment Sump. However, the equipment sump was not intended for either the quantity of air/water mixture or the entrained resins produced by demineralizer backwashing. This resulted in sump discharge to the HPCI room during demineralizer backwash. Due to a loose cap on a floor drain, approximately 12 inches of water accumulated in the B RHR pump room as well as in the HPCI room. Resin contamination was also evident in the HPCI room[5]. The licensee corrected this problem by securing the leaking floor drain and administratively requiring low sump level prior to demineralizer backwash. The above details introduce considerable uncertainty as to the long-term efficacy of the corrective actions implemented by the licensee thus far. The licensee is currently studying potential long-term corrective actions and can be expected to implement such actions when they are determined. The NRC Resident Inspector is following this subject and can be expected to require an adequate resolution based on his past efforts.

FINDINGS

Findings for this investigation were:

1) Resin migration through the ventilation system can produce a common mode failure of both trains of SBGTS.

2) The safety significance of this event is minimal due to the slow propogation rate and limited actual consequences of the resin migration.

3) Corrective actions by the licensee are adequate at present.

CONCLUSIONS

The safety significance of this event is relatively minor given the radiological release and system performance effects previously discussed. The personnel exposure effects may be more significant, especially since this has evidently been a problem for over three years. However, this review produced no evidence of excess personnel exposure. Given the limited significance discussed above, followup and resolution of this event by the resident inspector appears to be adequate. At present there is no need for additional AEOD involvement on this event. However, this type of common mode failure is potentially generic, depending on plant specific arrangement of demineralizer vents, SBGTS, and reactor building ventilation.

REFERENCES

1. LER 82-019/03L-0 on Pilgrim unit 1.
2. LER 79-020/03L-0 on Pilgrim Unit 1.
3. IE Inspection No. 50-293/82-20
4. Confirmative Action Letter 82-19
5. IE Inspection No. 50-293/82-30

ENCLOSURE 7
TO QUESTION 7

Event Evaluation Sheet

Initial Receiver	Date	Information Source	Subject
WIGGINTON	6/14/82	D.O. LOG (PN ISSUED) (82-42)	Spent resin release

Licensee/Facility Type/Location
PILGRIM / BWR / RI

Regional Contact
Greenman / Nimitz

Event Summary: 6/11/82, spent resin discovered on routine rad survey in plant — spill occurred sometime during past few weeks, resin on ground near buildings, on TB, RB, etc. roofs — believed to have exited building @ RB vent @ 100' elevation — some found on inlet plenum of SBGT system. Region dispatched 2–3 HP INSPECTORS TO SITE.

(SEE ~FEB 4, 1982 EES)

/ (Section Chief)

Further Action Required		Assigned to	WIGGINTON
Yes	No	(Assign Code #)*	

Followup Actions/Results

Looks like defect VENT ISOLATION VALVES ON demin, allowed [illegible] the VENTILATION SYSTEM —

→ Follow-up PN coming — RI got a confirmatory ACTION LETTER from LICENSEE

Evaluate further after PN issued.

Item Closed by/Date

Concurrence/Date
(Sect. Chief)

DCS No: 50293-820611
Date: June 11, 1982

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-I-82-42

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region I staff on this date.

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
____ Notification of Unusual Event
____ Alert
____ Site Area Emergency
____ General Emergency
__X__ Not Applicable

Subject: RELEASE OF SPENT RESIN

At approximately 1300 on June 11, 1982 spent resin was found on the ground near the Turbine Building. Subsequent surveys identified contamination of the roofs of the Turbine, Reactor, Off-Gas and Rx-Tube Buildings. Contamination was also found on the ground within the site controlled areas. Contamination levels ranged from 20-30,000 dpm/100 cm² with maximum contamination of up to 100,000 dpm/100 cm². Gamma isotopic analysis of the resin identified primarily long lived radionuclides (Co-60, Cs-137, Cs-134 and Mn-54).

No contamination was identified off-site or in storm drains. All personnel are being frisked prior to exiting the site and no personnel contamination has been identified.

The resin may have been released through the reactor building vent duct which exhausts to the atmosphere at an elevation of approximately 100 ft. The licensee has found approximately 10 ft³ of resin in the Standby Gas Treatment System inlet plenum. The source of the resin is being investigated. Three radiation specialists have been dispatched to the site to evaluate the radiological aspects of the occurrence.

Media interest is expected due to public interest in the facility. The licensee is considering issuing a press release. The NRC does not plan to issue a press release but will respond to media inquiries. The Commonwealth of Massachusetts has been informed.

This PN is current as of 4:45 P.M., June 11, 1982.

CONTACT: Elsasser 488-1235; Brunner 488-1225

DISTRIBUTION:

H St.____	MNBB____	Phillips____	E/W____	Willste____	Mail: ADM:DMB
Chairman Palladino	EDO	NRR	IE	NMSS	DOT:Trans. Onl
Comm. Gilinsky	PA		OIA	RES	
Comm. Ahearne	MPA		AEOD		
Comm. Roberts	ELD				
ACRS		Air Rights	INPO____		
SECY		SP	NSAC____		
CA					
PDR	Regional Offices ______		TMI Resident Section ____		
			RI Resident Office ____		

Licensee: ________
(Reactor Licensees)

Region I Form 83
(Rev. May 1982)

DCS No: 50293-820611
Date: June 14, 1982

PRELIMINARY NOTIFICATION OF EVENT OR UNUSUAL OCCURRENCE--PNO-I-82-42A

This preliminary notification constitutes EARLY notice of events of POSSIBLE safety or public interest significance. The information is as initially received without verification or evaluation, and is basically all that is known by the Region I staff on this date.

Facility: Pilgrim Nuclear Power Station
Plymouth, Massachusetts
DN 50-293

Licensee Emergency Classification:
___ Notification of Unusual Event
___ Alert
___ Site Area Emergency
___ General Emergency
X Not Applicable

Subject: RELEASE OF SPENT RESIN (UPDATE PNO-I-82-42)

Surveys of the entire site within the protected area and surveys of selected areas of the licensee controlled area were made within 3 hours of the identification of the spent resin release. The licensee's onsite surveys identified two contaminated pavement areas which were barricaded and posted. Surveys confirmed contamination of the Turbine, Administration, Quarters Offices and Radwaste Building roofs. The Reactor Building Roof was found to be free of contamination. The licensee's offsite survey included surveys of cars, parking lots, shorefront, and security access areas. No contamination was identified. Routine environmental air samples covering the period June 1-15, 1982 were counted. Nothing unusual was identified. Because of the size and weight of the resins, no offsite airborne release of the beads appears to have occurred. This was confirmed by air samples collected during clean-up of the contaminated pavement areas which when counted indicated background and the identification of resins only on roof-tops under the Reactor Buiding Vent. Preliminary samples of storm drain residue have been counted with no contamination identified. All contaminated ventilation ducts have been vacuumed clean. A duct surveillance program has been established to identify any additional resin accumulation.

The licensee believes the resin entered the ventilation ducts from the condensate demineralizer system during resin backwashing via the Cation Regeneration Tank Vent. In addition, resin from defective condensate demineralizer vent valves may have also been released prior to their repair during the September 1981 -March 1982 refueling outage. The resin appears to have been released from the Reactor Building Ventilation Exhaust System which vents above the reactor building roof, prior to the repair of defective filters in this system in September 1981.

The licensee has suspended all transfer operations which could result in further resin releases to ventilation ducts and has initiated additional environmental sampling. The licensee's actions were monitored by three Region I Radiation Specialists throughout the weekend. Region I will issue a Confirmatory Action Letter to address planned licensee corrective actions. The licensee is continuing to review the source and cause to determine what permanent corrective action will be needed. The Resident Inspectors are closely following licensee actions concerning this event.

Media interest has occurred. The licensee has responded to media inquiries but does not plan to issue a press release. The NRC will respond to media inquiries but does not plan to issue a press release.

This PN is current as of 11:00 a.m., June 14, 1982.

Region I Form 83
(Rev. March, 1982)

ENCLOSURE 3
TO QUESTION 7

SSINS No.: 6835
IN 82-43

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
WASHINGTON, D. C. 20555

November 16, 1982

IE INFORMATION NOTICE NO. 82-43: DEFICIENCIES IN LWR AIR FILTRATION/ VENTILATION SYSTEMS

Addressees:

All nuclear power reactor facilities holding an operating license (OL) or construction permit (CP).

Purpose:

This information notice is provided as notification of events that had actual or potential radiological impact on the plant environs. It is expected that recipients will review the information for applicability to their facilities. No specific action or response is required.

Description of Circumstances:

Within the past 2-1/2 years, air filtration/ventilation systems at five facilities were found to have serious deficiencies, ranging from overloaded prefilters to evidence of a wetted high-efficiency particulate air (HEPA) filter bank, to penetration of HEPA filter banks by substantive quantities of radioactive resin beads. Deficiencies occurred in both safety-related and non-safety-related systems.

In June 1982, radioactive spent resin was found on the grounds and roof areas at Pilgrim 1. Principal radionuclides were Co-60, Cs-137, Cs-134, and Mn-54; contamination ranged from 20,000 dpm/100 cm^2 to 100,000 dpm/100 cm^2. The contamination penetrated damaged filters in a non-safety-grade HEPA filter plenum. The degraded condition of these filters was not detected in a timely manner because of a lack of surveillance or testing of the filtration system. The HEPA filter failure occurred possibly as an end result of a combination of high dust loadings and mechanical damage resulting from the impact of disintegrating prefilters, as well as the probable warping or distortion of HEPA filter frames under prolonged exposure to water and high humidity.

In December 1980, the SGTS trains at Brunswick 1 were found to be operating at close to 100% humidity, and condensation was observed on the interior walls. Regulatory Guide 1.52 recommends operation at humidity of 70% or less; operation at high humidity is known to cause substantial degradation of the iodine-retention capacity of charcoal adsorbers. Also, in December 1980, both filter trains in the turbine building filter system at Brunswick were found to be operating with the upstream HEPA differential pressure gauges offscale high. Also, in the turbine building filter system, 43% of the upstream HEPA filters were improperly installed.

8208190248

In August 1980, filters and charcoal adsorbers in the Surry 1 process vent exhaust air treatment system were determined to have been half submerged in water, and the HEPA filters were caked with dust. No pressure drop instrumentation was provided across the filter banks to ascertain their state of loading. Also, in August 1980, pressure drop gauges across the HEPA filter banks in the ventilation exhaust treatment system of the auxiliary building at Surry 1 exceeded 5 inches, which is offscale high; this condition had existed since May 1980.

In May 1980, the normal containment building exhaust filters at Turkey Point were found to be overloaded with dust to such an extent that the filter medium was separated from its frame in more than 50% of the filters. This apparently allowed radioactive contamination resulting from explosive plugging of steam generator tubes to be transported to the southeast sector of the plant site.

In March 1980, it was determined that HEPA filters in the Big Rock Point offgas and chemistry laboratory exhaust treatment systems were not being tested for leakage in place. No records were maintained of pressure differential across the laboratory HEPA filters which had not been replaced for at least five years.

In each case described above, licensees initiated programs and procedures to correct the deficiencies and to prevent or minimize their potential for reoccurrence.

Air treatment systems which incorporate filtration or adsorption media are provided to reduce the potential release of radioactive materials to the environs. In order to function as designed, such systems should be installed, tested, and maintained to a degree consistent with their intended function.

Guidance on installation, maintenance, and testing programs, of a degree and nature which have been demonstrated to ensure proper system functioning, is provided in Regulatory Guides 1.52 and 1.140.

No written response to this information notice is required. If you need additional information about this matter, please contact the Regional Administrator of the appropriate NRC Regional Office or this office.

/s/ William Mills for
Edward L. Jordan, Director
Division of Engineering and
Quality Assurance
Office of Inspection and Enforcement

Technical Contacts: L. J. Cunningham, IE
301-492-8073

P. G. Stoddart, NRR
301-492-7633

ENCLOSURE 5
TO QUESTION 7

Pilgrim Nuclear Power Station

Radioactive Effluent and Waste Disposal Report including Radiological Impact on Humans

January 1 through June 30, 1982

By: Nuclear Operations Support Department
Environmental and Radiological
Health and Safety Group

Date: September 1, 1982

Boston Edison Company

IE25

PILGRIM NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT AND WASTE DISPOSAL REPORT
INCLUDING RADIOLOGICAL IMPACT ON HUMANS

JANUARY 1 THROUGH JUNE 30, 1982

Prepared by: Christine E. Bowman

Christine E. Bowman
Sr. Radiological Engineer

Approved by: Tom Sowdon

Thomas L. Sowdon
Environmental and Radiological Health
and Safety Group Leader

Date of Submittal: September 1, 1982

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1. INTRODUCTION AND SUMMARY

This report is issued for the period January-June 1982 in accordance with NRC Regulatory Guide 1.21 "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants" (Rev. 1). The information supplied includes actual effluent releases, radioactive waste and meteorological data; doses from liquid releases, doses from gaseous releases and direct gamma radiation doses.

2. EFFLUENT, WASTE DISPOSAL AND WIND DATA

Radioactive liquid and gaseous releases, wind speed data together with measurement errors and solid waste disposal information are given in Tables 1A, 1B, 1C, 2A, 2B, 3, 4A-1, 4A-2, and supplemental information section in the standard Regulatory Guide 1.21 format.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information
January - June 1982

Facility Pilgrim Nuclear Power Station Licensee DPR-35

1. **Regulatory Limits**
   a. Fission and activation gases $\frac{Qs}{0.25/\bar{E}} + \frac{Qv}{0.10/\bar{E}} \leq 1$
   b. Iodines 2Ci/Quarter
   c. Particulates, half-lives >8 days 13(1.8E4Qs+1.8E5Qv)≤1
   d. Liquid effluents: 10Ci/Quarter

2. **Maximum Permissible Concentration**

   Provide the MPCs used in determining allowable release rates or concentrations.
   a. Fission and activation gases
   b. Iodines:
   c. Particulates, half-lives >8 days

   } 10 CFR 20 Appendix B Table II

   d. Liquid effluents: H - 3 = 1 X 10^{-3} µCi/ml: all rest, 10 CFR 20, Appendix B, Table II

3. **Average Energy**

   Provide the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases, if applicable.
   MS =0.324:RBV=0.503

4. **Measurements and Approximations of Total Radioactivity**

   Provide the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.
   a. Fission and activation gases:
   b. Iodines:
   c. Particulates:
   d. Liquid effluents:

   } GeLi Isotopic Analysis

5. **Batch Releases**

   Provide the following information relating to batch releases of radioactive materials in liquid and gaseous effluents.

   a. Liquid
      1. Number of batch releases: 121
      2. Total time period for batch releases: 192.92hrs
      3. Maximum time period for a batch release - 7.75hrs
      4. Average time period for batch releases: 1.59hrs
      5. Minimum time period for a batch release - 0.25hrs
      6. Average stream flow during periods of release of effluent into a flowing stream. 1.90E+5GPM

   b. Gaseous (Not Applicable)

6. **Abnormal Releases**

   a.
   b. None

TABLE 1A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT
GASEOUS EFFLUENTS · SUMMATION OF ALL RELEASES
January - June 1982

	Unit	Quarter 1	Quarter 2	Est. Total Error, %
A. Fission and activation gases				
1. Total release	Ci	-	3.55E+3	2.50E+1
2. Average release rate for period	µCi/sec	-	4.52E+2	
3. Percent of Technical Specification limit	%	-	6.92E-2	
B. Iodines				
1. Total iodine-131	Ci	-	3.97E-3	2.54E+1
2. Average release rate for period	µCi/sec	-	5.05E-4	
3. Percent of Technical Specification limit	%	-	1.99E-1	
C. Particulates				
1. Particulates with half-lives > 8 days	Ci	<3.68E-4	4.26E-3	3.05E+1
2. Average release rate for period	µCi/sec	<4.73E-5	5.42E-4	
3. Percent of Technical Specification limit	%	<8.39E-3	6.98E-2	
4. Gross alpha radioactivity	Ci	<4.52E-7	<5.61E-7	
D. Tritium				
1. Total release	Ci	2.34E0	5.92E0	3.20E+1
2. Average release rate for period	µCi/sec	3.01E-1	7.52E-1	
3. Percent of Technical Specification limit	%	-	-	

TABLE 1B

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)

GASEOUS EFFLUENTS – ELEVATED RELEASE

January - June 1982

Nuclides Released	Unit	CONTINUOUS MODE Quarter	CONTINUOUS MODE Quarter	BATCH MODE Quarter	BATCH MODE Quarter
1. Fission gases					
krypton-85	Ci	-	1.37E-2		
krypton-85m	Ci	-	2.93E+2		
krypton-87	Ci	-	6.55E+1		
krypton-88	Ci	-	3.62E+2		
xenon-133	Ci	-	2.28E+3		
xenon-135	Ci	-	2.61E+2		
xenon-135m	Ci	-	<6.06E+0		
xenon-138	Ci	-	<2.38E+1		
xenon-131m	Ci	-	-		
xenon-137	Ci	-	-		
xenon-133m	Ci	-	4.28E+1		
Total for period	Ci	-	3.33E+3		
2. Iodines					
iodine-131	Ci	-	2.53E-3		
iodine-133	Ci	-	7.90E-3		
iodine-135	Ci	-	<6.55E-3		
Total for period	Ci	-	<1.70E-2		
3. Particulates					
strontium-89	Ci	< 6.32E-7	5.16E-4		
strontium-90	Ci	< 6.26E-8	5.50E-6		
cesium-134	Ci				
cesium-137	Ci	<1.04E-5	1.14E-5		
barium-lanthanum-140	Ci		1.57E-3		
chromium-51	Ci				
manganese-54	Ci	8.90E-6	2.90E-6		
cobalt-58	Ci				
iron-59	Ci				
cobalt-60	Ci	<7.86E-5	3.00E-5	-	
zinc-65	Ci				
zirconium-niobium-95	Ci				
cerium-141	Ci				
cerium-144	Ci				
ruthenium-103	Ci				
ruthenium-106	Ci				

TABLE 1C
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
GASEOUS EFFLUENTS - GROUND LEVEL RELEASE
January - June 1982

Nuclides Released	Unit	CONTINUOUS MODE Quarter	CONTINUOUS MODE Quarter	BATCH MODE Quarter	BATCH MODE Quarter
1. Fission gases					
krypton-85	Ci	-	1.01E-5		
krypton-85m	Ci	-	2.47E+1		
krypton-87	Ci	-	2.51E+0		
krypton-88	Ci	-	4.55E+1		
xenon-133	Ci	-	4.19E+1		
xenon-135	Ci	-	1.07E+2		
xenon-135m	Ci	-	-		
xenon-138	Ci	-	-		
Total for period	Ci	-	2.22E+2		
2. Iodines					
iodine-131	Ci	-	1.44E-3		
iodine-133	Ci	-	6.50E-3		
iodine-135	Ci	-	< 1.02E-2		
Total for period	Ci	-	< 1.81E-2		
3. Particulates					
strontium-89	Ci	1.64E-5	1.46E-3		
strontium-90	Ci	4.76E-7	1.44E-6		
cesium-134	Ci	1.17E-6			
cesium-137	Ci	2.42E-5	3.67E-5		
barium-lanthanum-140	Ci		3.95E-4		
manganese-54	Ci	1.08E-5	5.88E-6		
cobalt-58	Ci				
iron-59	Ci				
cobalt-60	Ci	2.16E-4	2.27E-4		
zinc-65	Ci				
zirconium-niobium-95	Ci				
cerium-141	Ci				
ruthenium-103	Ci				
ruthenium-106	Ci				

TABLE 2A
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES
January - June 1982

	Unit	Quarter 1	Quarter 2	Est. Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, noble gases, or alpha)	Ci	5.72E-1	1.44E-1	3.00E+1
2. Average diluted concentration during period	μCi/ml	8.91E-8	7.58E-8	
3. Percent of applicable limit	%	5.72E0	1.44E0	
B. Tritium				
1. Total release	Ci	5.26E0	1.99E-1	3.00E+1
2. Average diluted concentration during period	μCi/ml	8.19E-7	1.05E-7	
3. Percent of applicable limit	%	8.19E0	1.05E0	
C. Dissolved and entrained gases				
1. Total release	Ci	-	-	-
2. Average diluted concentration during period	μCi/ml	-	-	
3. Percent of applicable limit	%	-	-	
D. Gross alpha radioactivity				
1. Total release	Ci	$<$1.44E-4	$<$1.73E-5	4.00E+1
E. Volume of waste released (prior to dilution)	liters	1.61E6	1.10E5	2.00E+1
F. Volume of dilution water used during period	liters	6.42E9	1.90E9	2.00E+1

TABLE 2B
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)

LIQUID EFFLUENTS
January - June 1982

Nuclides Released	Unit	CONTINUOUS MODE Quarter	Quarter	BATCH MODE Quarter	Quarter
strontium-89	Ci			6.70E-4	1.89E-3
strontium-90	Ci			4.17E-4	1.65E-4
cesium-134	Ci			1.46E-2	7.42E-4
cesium-137	Ci			1.08E-1	6.60E-3
iodine-131	Ci			-	2.25E-6
cobalt-58	Ci			2.54E-3	8.23E-4
cobalt-60	Ci			2.44E-1	7.00E-2
iron-59	Ci			4.27E-5	3.06E-6
zinc-65	Ci			4.28E-3	1.20E-3
manganese-54	Ci			2.61E-2	1.01E-2
chromium-51	Ci			-	1.20E-5
zirconimum-niobium-95	Ci			5.16E-4	6.74E-4
molybdenum 99-technetium 99m	Ci			-	-
barium-lanthanum-140	Ci			-	4.96E-5
cerium-141	Ci			1.65E-5	-
iodine-133	Ci			-	2.70E-6
cerium-144	Ci			-	1.75E-5
silver-110m	Ci			-	-
iron-55	Ci			1.47E-1	2.43E-2
unidentified	Ci			2.40E-2	2.72E-2
Total for period (above)	Ci			5.72E-1	1.44E-1
xenon-133	Ci			-	-
xenon-135	Ci			-	-

TABLE 3

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT (1982)
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
JANUARY - JUNE 1982

A. SOLID WASTE SHIPPED OFF SITE FOR BURIAL OR DISPOSAL. (Not irradiated fuel.)

1. TYPE OF WASTE	UNIT	6 MONTH PERIOD	EST. TOTAL ERROR %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	97.299 123.60353	N/A N/A
b. Dry compressible waste, contaminated equipment, etc.	m^3 Ci	1539.11 10.67373	N/A N/A
c. Irradiated components, control rods, etc.	m^3 Ci	NONE	N/A
d. Other (Describe) Miscellaneous low-level waste	m^3 Ci	NONE	N/A

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION. (By Type of Waste)

		%	E(Curies)
a. Spent Resins, Filter	Sr90	.522	.64564
Sludges, Evap. Bottoms,	Sr89	19.972	24.68618
Diatomateous Earth, Etc.	Fe55	12.697	15.69454
	Cs134	4.156	5.13671
	Cs137	26.327	32.54062
	Co58	1.220	1.50773
	Mn54	2.712	3.35228
	Zn65	.450	.55669
	Co60	31.633	39.09916
	La-140	.019	.02323
	Ba-140	.005	.00623
	I-131	.004	.0049[illegible]
	Cr-51	.283	[illegible]
	TOTALS	100.000	123.60353

		%	E(Curies)
b. Dry Compressible Waste	Co60	50.24	5.36260
Contaminated Equipment	Co58	7.63	.81467
	Cs137	22.48	2.39956
	Cs134	6.75	.72011
	Fe55	1.75	.18635
	Fe59	1.14	.12171
	Sr89	.12	.01328
	Sr90	.01	.00027
	Zn65	.23	.02488
	Mn54	9.65	1.03030
	TOTALS	100.00	10.67373

c. N/A

d. N/A

3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
20	Tractor Trailer	Richland, Wash.
32	Tractor Trailer	Barnwell, S.C.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
NONE	N/A	N/A

PILGRIM NUCLEAR POWER STATION

Radioactive Effluent and Waste Disposal Report

Including

Radiological Impact on Humans

July 1 through December 31, 1982

BY: NUCLEAR OPERATIONS SUPPORT DEPARTMENT
ENVIRONMENTAL AND RADIOLOGICAL
HEALTH AND SAFETY GROUP

Date: March 1, 1983

BOSTON EDISON COMPANY

8303290478 830308
PDR ADOCK 05000293
R PDR

PILGRIM NUCLEAR POWER STATION
RADIOACTIVE EFFLUENT AND WASTE DISPOSAL REPORT
INCLUDING RADIOLOGICAL IMPACT ON HUMANS

JULY 1 THROUGH DECEMBER 31, 1982

Prepared By: Christine E. Bowman

Christine E. Bowman
Senior Radiological Engineer

Approved By: Thomas L. Sowdon

Thomas L. Sowdon
Environmental Radiological
Health and Safety Group Leader

Date of Submittal: March 1, 1983

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1. INTRODUCTION AND SUMMARY

This report is issued for the period July-December 1982 in accordance with NRC Regulatory Guide 1.21, "Measuring, Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants" (Rev. 1). The information supplied includes actual effluent releases, radioactive waste and meteorological data; doses from liquid releases, doses from gaseous releases and direct gamma radiation doses.

2. EFFLUENT, WASTE DISPOSAL AND WIND DATA

Radioactive liquid and gaseous releases, wind speed data together with measurement errors and solid waste disposal information are given in Tables 1A, 1B, 1C, 2A, 2B, 3, 4A-1, 4A-2, and supplemental information section in the standard Regulatory Guide 1.21 format.

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information

July-December 1982

Facility Pilgrim Nuclear Power Station Licensee DPR-35

1. **Regulatory Limits**

   a. Fission and activation gases $\frac{Qs}{0.25/\bar{E}} + \frac{Qv}{0.10/\bar{E}} = \leq 1$

   b. Iodines 2Ci per quarter

   c. Particulates half-lives >8 days 13(1.8E4Qs + 1.8E5Qv) ≤ 1

   d. Liquid effluents 10Ci per quarter

2. **Maximum Permissible Concentration**

   Provide the MPC's used in determining allowable release rates or concentrations

   a. Fission and activation gases
   b. Iodines
   c. Particulates, half-lives >8 days

   } 10 CFR 20 Appendix B Table II

   d. Liquid effluents H - 3 = 1 X 10^{-3} μCi/ml, all rest, 10 CFR 20, Appendix B, Table II

3. **Average Energy**

   Provide the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases if applicable $\bar{E}$ = 1 Mev

   MS = 0.304&0.287: RBV = 0.391&0.494 (3rd & 4th quarter)

4. **Measurements and Approximations of Total Radioactivity**

   Provide the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition

   a. Fission and activation gases
   b. Iodines
   c. Particulates
   d. Liquid effluents

   } GeLi Istopic Analysis

5. **Batch Releases**

   Provide the following information relating to batch releases of radioactive materials in liquid and gaseous effluents

   a. **Liquid**

      1. Number of batch releases 77
      2. Total time period for batch releases 87.48hrs
      3. Maximum time period for a batch release – 4.08hrs
      4. Average time period for batch releases 1.14hrs
      5. Minimum time period for a batch release – 0.33hrs
      6. Average stream flow during periods of release of effluent into a flowing stream 3.05E+5 GPM

   b. **Gaseous** **(Not Applicable)**

6. **Abnormal Releases**

   a.
   b. None

TABLE 1A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

July-December 1982

	Unit	Quarter (3)	Quarter (4)	Est. Total Error, %
A. Fission and activation gases				
1. Total release	Ci	< 1.07E+4	< 5.19E+3	2.49E+1
2. Average release rate for period	μCi/sec	< 1.35E+3	< 6.53E+2	
3. Percent of Technical Specification limit	%	< 1.77E-1	< 8.25E-2	
B. Iodines				
1. Total iodine-131	Ci	1.03E-2	9.32E-3	2.51E+1
2. Average release rate for period	μCi/sec	1.30E-3	1.17E-3	
3. Percent of Technical Specification limit	%	5.15E-1	4.66E-1	
C. Particulates				
1. Particulates with half-lives > 8 days	Ci	8.20E-3	8.01E-3	3.03E+1
2. Average release rate for period	μCi/sec	1.03E-3	1.01E-3	
3. Percent of Technical Specification limit	%	9.67E-2	8.72E-2	
4. Gross alpha radioactivity	Ci	< 5.14E-7	< 4.50E-7	
D. Tritium				
1. Total release	Ci	4.90E0	5.93E0	3.30E+1
2. Average release rate for period	μCi/sec	6.16E-1	7.46E-1	
3. Percent of Technical Specification limit	%	-	-	

TABLE 1B

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)

GASEOUS EFFLUENTS – ELEVATED RELEASE

July-December 1982

Nuclides Released	Unit	CONTINUOUS MODE Quarter (3)	CONTINUOUS MODE Quarter (4)	BATCH MODE Quarter	BATCH MODE Quarter
1. Fission gases					
krypton-85	Ci	1.62E-2	1.60E-2		
krypton-85m	Ci	7.69E+2	5.47E+2		
krypton-87	Ci	< 1.87E+2	< 4.58E+1		
krypton-88	Ci	8.99E+2	4.99E+2		
xenon-133	Ci	4.51E+3	3.07E+3		
xenon-135	Ci	3.73E+3	7.36E+2		
xenon-135m	Ci	< 1.54E+1	< 9.26E0		
xenon-138	Ci	< 3.75E+1	< 3.90E+1		
xenon-131m	Ci	-	-		
xenon-137	Ci	-	-		
xenon-133m	Ci	1.30E+2	8.49E+1		
Total for period	Ci	< 1.03E+4	5.03E+3		
2. Iodines					
iodine-131	Ci	4.66E-3	6.53E-3		
iodine-133	Ci	1.68E-2	2.24E-2		
iodine-135	Ci	< 1.22E-2	< 1.48E-2		
Total for period	Ci	< 3.37E-2	< 4.37E-2		
3. Particulates					
strontium-89	Ci	1.62E-3	2.78E-3		
strontium-90	Ci	1.73E-5	1.83E-5		
cesium-134	Ci	8.15E-6	2.61E-6		
cesium-137	Ci	7.38E-5	5.76E-5		
barium-lanthanum-140	Ci	3.55E-3	2.68E-3		
chromium-51	Ci	-	-		
manganese-54	Ci	1.28E-5	3.65E-6		
cobalt-58	Ci	-	2.09E-6		
iron-59	Ci	-	-		
cobalt-60	Ci	1.55E-4	3.97E-5		
zinc-65	Ci	-	-		
zirconium-niobium-95	Ci	-	-		
cerium-141	Ci	-	-		
cerium-144	Ci	-	1.53E-5		
ruthenium-103	Ci	-	-		
ruthenium-106	Ci	2.70E-5	-		

TABLE 1C
EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)
GASEOUS EFFLUENTS - GROUND LEVEL RELEASE
July-December 1982

Nuclides Released	Unit	CONTINUOUS MODE Quarter (3)	CONTINUOUS MODE Quarter (4)	BATCH MODE Quarter	BATCH MODE Quarter
1. Fission gases					
krypton-85	Ci	< 1.49E-5	5.03E-6		
krypton-85m	Ci	< 3.46E+1	1.21E+1		
krypton-87	Ci	< 9.16E0	< 4.07E0		
krypton-88	Ci	< 1.55E+1	2.43E+1		
xenon-133	Ci	1.41E+2	5.99E+1		
xenon-135	Ci	1.86E+2	5.86E+1		
xenon-135m	Ci	-	-		
xenon-138	Ci	-	-		
Total for period	Ci	< 3.86E+2	< 1.59E+2		
2. Iodines					
iodine-131	Ci	5.66E-3	2.79E-3		
iodine-133	Ci	2.63E-2	1.18E-2		
iodine-135	Ci	4.26E-2	2.10E-2		
Total for period	Ci	7.46E-2	3.56E-2		
3. Particulates					
strontium-89	Ci	1.29E-3	1.53E-3		
strontium-90	Ci	2.55E-6	2.53E-6		
cesium-134	Ci	1.89E-6	4.46E-6		
cesium-137	Ci	6.64E-5	2.14E-5		
barium-lanthanum-140	Ci	1.24E-3	7.85E-4		
manganese-54	Ci	1.25E-5	1.31E-6		
cobalt-58	Ci	-	3.74E-6		
iron-59	Ci	-	-		
cobalt-60	Ci	1.29E-4	5.90E-5		
zinc-65	Ci	-	-		
zirconium-niobium-95	Ci	-	-		
cerium-141	Ci	-	-		
ruthenium-103	Ci	-	-		
ruthenium-106	Ci	-	2.60E-5		

TABLE 2A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)

LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

JULY-December 1982

	Unit	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission and activation products				
1. Total release (not including tritium, noble gases, or alpha)	Ci	3.09E-2	1.25E-1	2.98E+1
2. Average diluted concentration during period	μCi/ml	7.39E-9	6.65E-8	
3. Percent of applicable limit	%	3.09E-1	1.25E0	
B. Tritium				
1. Total release	Ci	8.29E-4	4.55E-1	3.00E+1
2. Average diluted concentration during period	μCi/ml	1.98E-10	2.42E-7	
3. Percent of applicable limit	%	1.98E-3	2.42E0	
C. Dissolved and entrained gases				
1. Total release	Ci	-	5.39E-3	3.98E+1
2. Average diluted concentration during period	μCi/ml	-	2.87E-9	
3. Percent of applicable limit	%	-	-	
D. Gross alpha radioactivity				
1. Total release	Ci	< 6.60E-6	< 1.65E-5	4.01E+1
E. Volume of waste released (prior to dilution)	liters	8.47E+4	2.01E+5	2.00E+1
F. Volume of dilution water used during period	liters	4.18E+9	1.88E+9	2.00E+1

TABLE 2B

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT (1982)

LIQUID EFFLUENTS

July-December 1982

Nuclides Released	Unit	CONTINUOUS MODE 3rd Quarter	CONTINUOUS MODE 4th Quarter	BATCH MODE Quarter	BATCH MODE Quarter
strontium-89	Ci	1.64E-5	2.10E-5		
strontium-90	Ci	4.70E-5	7.78E-5		
cesium-134	Ci	3.30E-4	7.05E-4		
cesium-137	Ci	3.73E-3	9.65E-3		
iodine-131	Ci	5.87E-6	4.12E-5		
cobalt-58	Ci	4.42E-5	1.96E-3		
cobalt-60	Ci	8.67E-3	3.66E-2		
iron-59	Ci	3.49E-6	5.30E-4		
zinc-65	Ci	5.09E-5	5.37E-5		
manganese-54	Ci	6.49E-4	3.74E-3		
chromium-51	Ci	4.02E-5	6.57E-3		
zirconimum-niobium-95	Ci	-	1.21E-6		
molybdenum 99-technetium 99m	Ci	-	5.71E-5		
barium-lanthanum-140	Ci	1.03E-6	4.38E-5		
cerium-141	Ci	2.14E-6	1.10E-4		
iodine-133	Ci	-	3.04E-6		
cerium-144	Ci	-	-		
silver-110m	Ci	-	8.01E-4		
iron-55	Ci	1.28E-2	2.41E-2		
unidentified	Ci	4.49E-3	3.95E-2		
Total for period (above)	Ci	3.09E-2	1.25E-1		
xenon-133	Ci	-	2.18E-3		
xenon-135	Ci	-	3.21E-3		

TABLE 3

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT (1982)
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
JULY - DECEMBER 1982

A. SOLID WASTE SHIPPED OFF SITE FOR BURIAL OR DISPOSAL. (not irradiated fuel)

1. TYPE OF WASTE	UNIT	6 MONTH PERIOD	EST. TOTAL ERROR %
a. Spent resins, filter sludges,	m^3	99.007	N/A
evaporator bottoms, etc.	Ci	819.10	N/A
b. Dry compressible waste,	m^3	547.666	N/A
contaminated equipment, etc.	Ci	5.14564	N/A
c. Irradiated components,	m^3	none	N/A
control rods, etc.	Ci	none	N/A
d. Other (describe)	m^3	none	N/A
Miscellaneous low-level waste	Ci	none	N/A

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION. (by type of waste)

		%	E(Curies)
a. Spent Resins, Filter	Co-60	41.324	338.48620
Sludges, Evaporator	Co-58	3.864	31.65107
Bottoms, etc.	Cs-137	13.426	109.97068
	Cs-134	1.489	12.19371
	Fe-55	11.164	99.44832
	Fe-59	.597	4.89055
	I-131	.464	3.79925
	I-133	.070	.57668
	La-140	.220	1.80569
	Ba-140	.019	.15592
	Sr-89	15.478	126.78505
	Sr-90	.345	2.82477
	Sr-91	.003	.02146
	Tc-99m	.040	.32557
	Zn-65	.723	5.92615
	Mn-54	4.614	37.79740

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION. (by type of waste)

CONTINUED

		%	E(Curies)
a. Spent Resins, Filter Sludges,	Nb-95	.002	.01495
Evap. Bottoms, Diatomateous	Cr-51	6.090	49.88606
Earth, etc.	Ag-110m	< .001	.00641
continued	Ce-141	.030	.24916
	Ru-103	.014	.11290
	Sr-92	.001	.00691
	Sb-124	.010	.08267
	Xe-133	< .001	.00034
	Xe-135	.004	.03266
	Mo-99	.007	.05629
	TOTAL:	100.000	819.10682

		%	E(Curies)
b. Dry Compressible Waste,	Co-60	17.46	.89843
Contaminated Equipment	Co-58	6.32	.32546
	Cs-137	6.04	.31058
	Cs-134	1.65	.08565
	Fe-59	1.17	.06038
	I-131	2.74	.14116
	Ba-140	3.76	.19341
	Zn-65	.86	.04430
	Mn-54	3.39	.17448
	Cr-51	56.60	2.91179
	TOTAL:	100.000	5.14564

c. N/A

d. N/A

3. SOLID WASTE DISPOSITION

Number of Shipments	Mode of Transportation	Destination
37	Tractor Trailer	Barnwell, S.C.
2	Tractor Trailer	Richland, Wash.

4. IRRADIATED FUEL SHIPMENTS (Disposition)

Number of Shipments	Mode of Transportation	Destination
none	N/A	N/A

<u>QUESTION 8.</u> In recent years, Boston Edison has had unsatisfactory ratings in the area of fire protection. I would like to know if Pilgrim is now in full compliance with fire protection requirements? Are all barriers, fire doors and penetration seals repaired and capable of passing required testing? Are fire watches still required in certain areas of the plant? How many fire watches are still needed? Will the NRC require Edison to complete the upgrading of the entire fire protection system prior to allowing restart? How many maintenance requests are still outstanding in the area of fire protection? Please also comment on the condition of the Halon system in the computer room at the plant and the smoke detectors over the spent fuel pool.

<u>ANSWER.</u>

Pilgrim is either in compliance or will be in compliance with its fire protection requirements prior to restart.

During the last one and one-half to two years, Boston Edison Company has made significant improvements in their entire fire protection program. Additional personnel with extensive experience in nuclear power plant fire protection have been hired. Realignment of responsibilities and authority among these licensee personnel have strengthened the entire fire protection program and

QUESTION 8. (Continued) 2

provided a higher level of accountability and continuity of effort that has resulted in substantial improvement in the program. This is evidenced by the methodology and thoroughness exhibited in identifying and correcting deficiencies.

One activity of the additional licensee fire protection personnel described above was the licensee has performed a reevaluation of plant fire protection features, comparing those features against NRC requirements and guidance, in an effort to determine (a) the level of actual compliance, and (b) the adequacy of the features provided to prevent unacceptable fire damage.

During the course of this reevaluation the licensee found several cases where they did not literally comply with the NRC requirements or specific commitments they had made earlier. The licensee, however, provided justification to demonstrate adequate protection against unacceptable fire damage and on that basis, asked for exemptions from those requirements. In most cases the staff granted the exemptions. In those cases where the staff did not agree with the justification provided, the licensee made modifications so as to be in compliance.

Because of the more or less constant activity at operating plants, temporary changes, repairs and, modifications, may result in a particular condition that is not in compliance. These situations are contemplated by the licensee and provisions are in place to assist in identifying the situation beforehand, providing interim protection measures (such as fire watches) and maintaining administrative control of the situation to assure that the out-of-compliance condition is corrected.

QUESTION 8. (Continued) 3

The licensee has indicated that all modifications and work associated with upgrading required fire barriers, fire doors and penetration seals has been completed. The licensee has committed to having all of the necessary documentation concerning the above work completed prior to plant startup.

Fire watches continue to be used in some areas at Pilgrim as well as most operating plants. At the beginning of the present outage approximately 18 months ago, eight persons per shift were assigned full time responsibility for continuous or roving fire watches covering approximately 180 individual deficiencies. As of March 17, 1988, no continuous fire watches are required. Two persons per shift are assigned roving as fire watches covering 41 separate deficiencies throughout the entire plant. Of those 41 deficiencies, 25 are related to fire barriers, 15 are related to maintenance activities, and one is related specifically to activities pertaining to the outage.

Some minor upgrading to the fire protection systems may remain at the time Pilgrim restarts. However, those modifications yet to be completed will have been identified and the schedules for completion will have been reviewed for acceptability by the staff.

One hundred and sixty-one maintenance requests were still outstanding in the area of fire protection on March 17, 1988. However, this number by itself does not give an accurate picture of the Pilgrim fire protection maintenance program. On January 5, 1987 there were 260 open maintenance requests related to fire protection. Since January 1, 1987, approximately 1,480 new fire protection-related maintenance requests have been generated and approximately 1,580 have been closed.

QUESTION 8. (Continued) 3

You also asked for our comments on the condition of the Halon System in the computer room, and smoke detectors over the spent fuel pool. A computer located in a small room adjacent to the Cable Spreading Room is being phased out. The room is protected by an operable automatic Halon fire suppression system. A new plant computer has been installed next to the Technical Support Center and the primary fire protection is provided by a sprinkler system with secondary protection provided by an automatic Halon fire suppression system. Both of these systems are operable.

Six smoke detectors are located over the Spent Fuel Pool in the ventilation system exhaust ducts. Four of the six detectors have already been tested during this current plant outage. The other two are scheduled for testing prior to plant startup.

<u>QUESTION 9</u>. How many automatic and manual scrams have occurred at Pilgrim since the plant became operational? What is the annual industry-wide average?

<u>ANSWER</u>.

Table 1 provides data on unplanned automatic and manual scrams during operational modes (criticality to 100% power) for Pilgrim from 1984 through 1987 compiled from licensee event reports submitted pursuant to 10 CFR Part 50.72 and 10 CFR Part 50.73. The comparable industry average rates are also provided in Table 1. Prior to 1984, reactor scrams were not directly reportable to the NRC (Pilgrim entered commercial service December 1, 1972).

Enclosure:

Table of Unplanned Scrams
When Critical for Pilgrim
and Industry

Enclosure to Question 9

Table 1

Unplanned Scrams When Critical for Pilgrim and Industry

1984 - 1987

	1984*	1985	1986	1987**
Pilgrim				
Automatic	0	4	4	0
Manual	0	0	0	0
Industry Average				
Automatic	5.4	5.0	4.0	3.2
Manual	0.6	0.5	0.5	0.6

*Pilgrim critical hours for 1984 = 170.

**Pilgrim critical hours for 1987 = 0.

QUESTION 10. How many "Unusual Events" and how many "Alerts" have been declared at Pilgrim since 1972? Please describe and give the date of each report. How does this compare to the industry-wide average?

ANSWER.

The NRC did not use the terms "unusual events" and "alerts" until 1980 and did not established them as reportable categories in our regulations until 1983. Our computer records of notifications to the NRC Operations Center show that Pilgrim has declared 12 Unusual Events and no Alerts since 1983. Of the 12 Unusual Events, 2 were caused by fires in nonsafety related equipment, and 1 was due to a potentially contaminated individual being transferred offsite for medical treatment. The remainder were attributed to safety system inoperability, which necessitated shutdown of the plant in accordance with the plant's Technical Specifications. Two tables are enclosed - the first compares the number of unusual events at Pilgrim since 1983 with the industry average per year; and the second provides descriptive data and the date for each unusual event at plants.

Enclosure:

Tables of Unusual Events at
Pilgrim Nuclear Station

QUESTION 10. (Continued) 2

A comparison of Pilgrim Unusual Events versus the industry average follows:

Year	Industry Unusual Events	Licensed Units	Industry Average	Pilgrim Unusual Events
*1982	-	-	-	-
1983	205	85	2.4	0
1984	224	91	2.0	1
1985	312	98	3.2	5
1986	209	104	2.0	5
1987	231	109	2.1	0
*1988	-	-	-	-
5 Year Total			11.7	11

*This table was prepared from data contained in computerized data base from August 1982 to the present. For comparison purposes, incomplete data for 1982 and 1988 are not shown. However, Pilgrim did report Unusual Events (a fire in a face mask fitting machine) on August 18, 1982 and on February 11, 1988 (a fire in the machine shop). Pilgrim also had one Alert on June 3, 1982 relating to a withdrawn incore detector resulting in abnormal radiation levels. This event lasted approximately 2 hours. Pilgrim had no other Alerts from 1983 to 1987; however, Alerts have been reported from other licensed facilities.

QUESTION 10. (Continued) 3

Enclosure to Question 10

Unusual Events at Pilgrim Nuclear Station

August 1983 to Present

Event	Description
4/26/84	Potentially contaminated man taken to hospital.
5/16/85	2 safety system trains inoperable.
05/23/85	2 safety system trains inoperable.
09/20/85	2 safety system trains inoperable.
10/15/85	2 safety system trains inoperable.
11/04/85	Residual Heat Removal safety train A inoperable.
01/04/86	2 of 8 Main Steam Isolation Valves fail closure time test.
01/09/86	Fire in line to hydrogen storage tanks.
02/11/86	Low pressure coolant injection inoperable.
02/14/86	2 safety system trains inoperable.
04/11/86	Loss of containment integrity.
02/11/88	Fire in machine shop.

QUESTION 11. How many violations of NRC regulations have occurred at Pilgrim since it began operation? What is the industry-wide average?

ANSWER.

The NRC does not maintain industry wide statistics on the total numbers of violations per plant.

In order to provide this requested data for the Pilgrim facilties, a review of inspection report data was performed. Our review indicated that Pilgrim was cited approximately 425 times for violations or deviations since the plant began operation in June, 1972 through the end of 1987. This number however, does not reflect whether the citations involved individual or multiple violations, whether the citations were subsequently withdrawn, or the severity level of the violations. Moreover, enforcement history is only one of a variety of factors NRC considers in assessing licensee performance.

QUESTION 12. There have been a number of allegations concerning the illegal dumping of radioactive waste on Boston Edison property. Concerns have also been raised over Edison's use of the town dump for disposal of radioactive material. Would you please describe what monitoring the NRC conducts or requires on materials and waste leaving the Pilgrim site. Has the NRC or the licensee performed tests on Edison property and at the town dump to ensure that there are no elevated levels of radiation at areas suspected of containing radioactive waste? Where and when were tests conducted? What were the results?

ANSWER.

The NRC staff does not itself monitor materials and waste leaving the Pilgrim site. The licensee is required to monitor all items containing or contaminated with radioactivity that leave the site and there are several facility procedures that provide specific guidance and instructions to plant health physics workers regarding this activity. All radioactive wastes that are sent to sites specifically intended for burial must meet federal regulations for radiation dose rate and contamination levels as well as special requirements of the burial sites. NRC performs routine inspections of the radioactive transportation area to ensure that licensees are conforming to these regulatory requirements. Further, onsite materials that have the potential of being contaminated and are being shipped offsite are surveyed prior to being shipped. The licensee is not allowed to dispose of contaminated objects in non-radwaste facilities without obtaining a special variance required by in 10 CFR Part 20.302(a). BECo has not applied for

QUESTION 12. (Continued) 2

these variances. To our knowledge, no contaminated objects have been disposed of in the town dump or in other public facilities not specifically intended for contaminated objects.

The NRC received allegations that contaminated shrubs had been removed from the site and improperly disposed of on BECo property in 1987. NRC inspectors determined that appropriate surveys were performed, measurements were within established limits and properly recorded prior to offsite disposal. An NRC inspector accompanied by the licensee collected clippings from the shrubs which were disposed of offsite. The clippings were independently analyzed by the NRC. Only one sample had detectable levels when we used sensitive laboratory instruments but was not detectable using standard survey meters.

The contamination levels were lower than typical soil background levels and they posed no health hazard (see pages 12 - 13 of the enclosed Inspection Report 50-293/87-57, dated March 11, 1988, p.12). NRC has not performed surveys for contamination of the town dump or at other BECo properties and does not routinely perform contamination surveys of this type. As stated in the Inspection Report, the inspectors reviewed the licensee's program for release of material from the site and concluded that it was adequate.

Enclosure:

Inspection Report dated 3/11/88

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION I
475 ALLENDALE ROAD
KING OF PRUSSIA, PENNSYLVANIA 19406

Enclosure to Question 12

MAR 1 4 1988

Docket No. 50-293

Boston Edison Company
ATTN: Mr. Ralph G. Bird
Senior Vice President - Nuclear
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

Subject: Region I Inspection Report No. 50-293/87-57

This refers to the routine safety inspection (50-293/87-57) conducted by Messrs. C. Warren, J. Lyash and T. Kim of this office on December 7, 1987 to January 19, 1988 at the Pilgrim Nuclear Power Station, Plymouth, Massachusetts. Areas examined during this inspection are described in the NRC Region I Inspection Report which is enclosed with this letter.

Based on the results of this inspection, it appears that one of your activities related to high radiation area access control was not conducted in full compliance with NRC requirements, as set forth in the Notice of Violation enclosed herewith as Appendix A. The problem was identified by your staff. However, a Notice of Violation is being issued because effective corrective actions apparently have not been taken for previous problems with high radiation area access control. In addition to following the instructions of Appendix A in preparing the required response, please include those actions you intend to take to preclude recurrence of this problem by insuring that your corrective actions are effective and lasting.

Two significant integrated plant tests were successfully executed during the inspection period. Preplanning and control of these activities was generally strong. We also observed that increased management involvement in assuring effective problem followup has resulted in substantial improvement. Equipment failures identified as a result of an unanticipated safety system actuation however, indicate the need for stronger post-work test practices and a thorough power ascension test program.

The response directed by this letter and the accompanying Notice are not subject to the clearance procedures of the Office of Management and Budget as required by the Paperwork Reduction Act of 1980, PL 96-511.

Boston Edison Company 2 MAR 1 1 198?

Your cooperation with us in this matter is appreciated.

Sincerely,

Samuel J. Collins

Samuel J. Collins, Deputy Director
Division of Reactor Projects

Enclosures:
1. Appendix A, Notice of Violation
2. NRC Region I Inspection Report No. 50-293/87-57

cc w/encls:
R. Barrett, Nuclear Operations Manager
B. McIntyre, Chairman, Department of Public Utilities
Chairman, Plymouth Board of Selectmen
Chairman, Duxbury Board of Selectmen
Plymouth Civil Defense Director
J. Keyes, Boston Edison Regulatory Affairs and Programs
E. Robinson, Nuclear Information Manager
R. Swanson, Nuclear Engineering Department Manager
The Honorable Edward J. Markey
The Honorable Edward P. Kirby
The Honorable Peter V. Forman
S. Pollard, Secretary of Energy Resources
P. Agnes, Assistant Secretary of Public Safety, Commonwealth of Massachusetts
R. Shimshak, MASSPIRG
Public Document Room (PDR)
Local Public Document Room (LPDR)
Nuclear Safety Information Center (NSIC)
NRC Resident Inspector
Commonwealth of Massachusetts (2)

bcc w/encls:
Region I Docket Room (with concurrences)
W. Russell, RA
M. Perkins, DRMA (w/o encls)
R. Blough, DRP
L. Doerflein, DRP
R. Bores, DRSS
S. Collins, DRP
C. Anderson, DRS
D. McDonald, LPM, NRR
T. Chandrasekaran, SPLB, NRR
M. Callahan, OCA
J. Nickerson

APPENDIX A

NOTICE OF VIOLATION

Boston Edison Company
Pilgrim Nuclear Power Station

Docket No. 50-293
License No. DPR-35

As a result of the inspection conducted on December 7, 1987 to January 19, 1988, and in accordance with the NRC Enforcement Policy (10 CFR 2, Appendix C), the following violation was identified. Three previous Notices of Violation dated March 13, March 23, 1987, and April 28, 1987 were issued for problems related to the control of Locked High Radiation Areas. It is evident that corrective actions taken in response to these Notices of Violation have not been effective in precluding recurrence.

The Station Technical Specification 6.11, "Radiation Protection Program," requires that "procedures for personnel radiation protection shall be prepared consistent with the requirements of 10 CFR 20 and shall be approved, maintained and adhered to for all operations involving personnel radiation exposure."

The Station Procedure 6.1-012, "Access to High Radiation Areas," requires in part that the areas controlled under this procedure remain locked or guarded at all times.

Contrary to the above, on December 15, 1987, December 27, 1987, and on January 8, 1988, doors to the areas being controlled as Locked High Radiation Areas were found to be unlocked and unattended, in violation of the Station Procedure 6.1-012.

This is a Severity Level IV Violation (Supplement I).

Pursuant to the provisions of 10 CFR 2.201, Boston Edison Company is hereby required to submit to this office within thirty days from the receipt of the letter which transmitted this Notice, a written statement or explanation in reply, including: (1) the corrective steps which have been taken and the results achieved; (2) corrective steps which will be taken to avoid further violations; and (3) the date when full compliance will be achieved. Where good cause is shown, consideration will be given to extending this response time.

U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket/Report No.	50-293/87-57
Licensee:	Boston Edison Company 800 Boylston Street Boston, Massachusetts 02199
Facility:	Pilgrim Nuclear Power Station
Location:	Plymouth, Massachusetts
Dates:	December 7, 1987 - January 19, 1988
Inspectors:	C. Warren, Senior Resident Inspector J. Lyash, Resident Inspector T. Kim, Resident Inspector
Approved By:	A. Randy Blough, Chief Reactor Projects Section No. 3B — 3-11-88 Date

Areas Inspected: Routine resident inspection of plant operations, radiation protection, physical security, plant events, maintenance, surveillance, outage activities, and reports to the NRC. The inspection consisted of 350 hours of direct inspection. Principal licensee management representatives contacted are listed in Attachment I. Observations made by the NRC Region I, Regional Administrator during a tour on December 8, 1987 are documented in Attachment II of this report. A copy of Attachment II was provided to licensee management for followup.

Results:

Violation: Repeated occurrences of locked high radiation area doors being left open and unattended were identified by the licensee. Problems with high radiation area access control have been previously identified and were the subject of violations during inspections 50-293/87-03 and 50-293/87-11. Corrective actions taken in response to these findings have not prevented their recurrence. (Section 3.b, VIO 87-57-01)

Unresolved Item: The licensee identified that two reactor vessel level gauges were incorrectly installed. A licensee investigation is currently ongoing to determine the cause and to assess the adequacy of post installation test. (Section 4.d, UNR 87-57-02)

Concerns:

1. The licensee experienced safety related equipment malfunctions upon receiving a spurious reactor scram signal on January 17, 1988. (Section 4.d)

2. Inadequate procedures and planning of surveillance tests resulted in unnecessary engineered safety feature actuations. (Section 3.a)

3. Poor preplanning and control of maintenance was noted during an electrical relay replacement. A similar problem was the subject of a violation during inspection 50-293/87-50. (Section 4.c)

4. Weak identification and tracking of lifted leads and jumpers led to a water spill in the high pressure coolant injection system room during the integrated leak rate test. (Section 6.0)

5. The prelube pump for the "B" emergency diesel generator failed to restart during a surveillance test. An identical failure occurred during a loss of offsite power event on November 12, 1987. Licensee followup appeared adequate but the failure root cause has not been identified. (Section 3.b)

6. The inspectors evaluated the erosion of construction dirt into wetlands area. The inspector's independent survey of the area, and the licensee's analyses indicate that the level of activity does not represent a health or safety concern. However, the material should not be allowed to erode. (Section 3.c)

Strengths:

1. The licensee's preparation and execution of the reactor vessel hydrostatic test was well organized and controlled. (Section 5.0)

2. The licensee's response to a January 17, 1988 reactor scram signal and subsequent equipment malfunctions was prompt, thorough and effective. (Section 4.d)

3. Using non-nuclear steam for testing of high pressure coolant injection system and reactor core isolation cooling system enabled the licensee to discover problems which may not have been easily identifiable using nuclear steam due to radiological conditions. (Section 3.b)

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DETAILS

1.0 Summary of Facility Activities

The plant was shutdown on April 12, 1986 for unscheduled maintenance. On July 25, 1986, Boston Edison announced that the outage would be extended to include refueling and completion of certain modifications. The reactor core was defueled on February 13, 1987. The licensee completed fuel reload on October 14, 1987. Reinstallation of the reactor vessel internal components and the vessel head was also subsequently completed.

During this report period, the licensee performed the reactor vessel hydrostatic test and the primary containment integrated leak rate test (ILRT) as described in Sections 5.0 and 6.0. On December 9, 1987, Pilgrim Station conducted a partial participation emergency preparedness exercise. On December 14, 1987 the licensee announced as part of a planned management realignment, the appointment of eight managers to key management positions in the licensee nuclear organization at Pilgrim Station. The details of the management realignment are described in Section 7.0.

NRC inspection activities during the report period included: 1) observation of the licensee's annual emergency preparedness exercise on December 9, 1987, 2) NRC Reactor Operator Licensing examinations were administered to eight candidates on the week of December 7, 1987, 3) observation of the primary containment ILRT and review of the test results during the week of December 21, 1987. The results of these inspections are documented in inspection reports 50-293/87-54, 50-293/87-56, and 50-293/87-58. In addition, representatives of the NRC's Office of Investigation were onsite December 3, December 7, and December 8, 1987 to interview onsite security personnel. On December 8, 1987, the NRC Regional Administrator for Region I, Mr. William T. Russell, toured the plant with the resident inspectors. On January 7, 1988, Dr. Thomas E. Murley, Director of the Office of Nuclear Reactor Regulation (NRR) and other NRC representatives toured the plant with the resident inspectors.

2.0 Followup on Previous Inspection Findings

(Closed) Unresolved Item 82-24-02 - Discrepancies in the Licensee's Response to IE Bulletin 79-08

Previous reviews of this item are documented in the inspection reports 50-293/82-30, 50-293/83-01, 50-293/83-14, and 50-293/84-26. IE Bulletin (IEB) 79-08 and the TMI Action Plan Item II.E.4.2 required licensees to review the containment isolation initiation design and procedures to ensure proper initiation of containment isolation, upon receipt of an automatic containment isolation signal. The licensee provided the results of their review in letters dated April 25, and August 21, 1979.

The licensee stated that the RBCCW supply and return lines, instrument air line, RHR to spent fuel pool cooling tie line, and torus make up line would be manually isolated and that station procedures would specify the requirements for manual isolation if a containment isolation signal was received. This was documented as acceptable by NRC:NRR in letters to the licensee dated December 18, 1979 and April 3, 1980. However, an inspector identified that manual isolation of these lines with qualified valves is not possible. Any valve which is used for primary containment isolation must meet Seismic Class I (FSAR section 12.2) and applicable 10 CFR 50, Appendix J, containment leakage testing criteria. Further, if manual operation of a valve is required to effect containment isolation, the isolation point for the valve must also be accessible under those conditions which make its use necessary.

In response to the inspector's questions, the licensee re-evaluated their response to the IEB 79-08 and TMI Action Plan Item II.E.4.2, and concluded that isolation of these lines is assured by the use of Seismic Class I check valves. The licensee also agreed that isolation for the RBCCW supply line, instrument air line, RHR to spent fuel pool cooling tie line, and torus makeup line cannot be performed by manual valve closure. The RBCCW return line from the drywell can meet the isolation valve criteria with MOV-4002 which is seismic class I, local leak rate tested and can be closed by a control switch located in the main control room. The licensee subsequently submitted a supplemental response to IE Bulletin 79-08 and TMI Action Plan Item II.E.4.2 on October 24, 1984 correcting the previous response. The inspector reviewed the supplemental response and verified that the contents were consistent with the conclusions drawn from the licensee's re-evaluation and the FSAR. Both RBCCW supply line and instrument air line are considered Class C lines in Section 7.3 of the FSAR since they penetrate containment but have no interaction with the primary containment free space or the reactor vessel. According to the original design criteria, a single check valve is provided to attain isolation for a Class C line. These check valves are seismic class I and local leak rate tested. The inspector reviewed the results of local leak rate test data for these check valves which were performed on June 12 and July 26, 1987 and found no discrepancies. The torus makeup line is identified as Class B in Section 7.3 of the FSAR. The torus makeup line is non-essential and ties the condensate transfer system into the RHR test line, which penetrate primary containment and ends below the torus water level. For water-sealed Class B lines such as the torus makeup system, the original plant design bases allow one isolation valve in addition to the water seal to meet isolation requirements. Also, the Safety Evaluation by the NRR on Appendix J Review indicate that Type C testing is not required for valves in lines which terminate below the level of the suppression pool. As for the RHR to spent fuel pool line, the licensee revised the operating procedures 2.2.85, Fuel Pool Cooling and Filtering System, prohibiting the use of the RHR to spent fuel pool lines except in cold shutdown. The inspector had no further questions. This item is closed.

<u>(Closed) Inspector Follow Item (IFI 87-27-02) - Cracking of Surge Ring Brackets in Large GE Motors</u>

On July 2, 1987, IE Information Notice 87-30, Cracking of Surge Ring Brackets in large GE motors, was issued. The purpose of the notice was to alert recipients of a potential for failure of surge ring brackets and cracking of felt blocks in large, vertical electric motors manufactured by General Electric Co. Felt blocks are used in large electric motors to keep the windings separated where they loop back at the end of the stator. The blocks are attached to a surge ring that is held in place by L-shaped surge ring brackets welded to the surge ring and bolted to the motor casing. Failure of these surge ring brackets and cracking of the felt blocks allows movement and wear of the end-turns, leading to a reduction in insulation resistance and possible motor failure. In addition, broken pieces of the surge ring bracket may enter the space between the stator and the rotor, resulting in electrical or mechanical motor degradation.

Following an investigation to determine the applicability of the subject notice to the Pilgrim Station, the licensee found that RHR, core spray, and recirculation pump motors were potentially affected. RHR and core spray pump motors were overhauled on site by GE under contract with the licensee in 1986. The surge ring brackets were not inspected during the overhaul. However, small cracks were found on the "A" and "C" RHR pump motor winding felt blocks. The amount of cracking found was dispositioned by GE to be acceptable and a normal phenomenon found in form-wound motors. On July 27 through August 5, 1987, GE performed a surge ring bracket inspection of the RHR and recirculation pump motors using a boroscope with the motors in place. The inspection of the RHR motors (A thru D) revealed absence of cracks on the surge ring brackets. During the inspection of the "B" recirculation pump motor, it was noted that the recirc motor surge ring bracket construction is of the bolt and stud design, whereas the RHR and core spray motor brackets are of the L-shaped design. The L-shaped design configuration is known to have the potential of cracking, according to the IE Notice 87-30 and the GE letter to the licensee dated July 14, 1987.

During the week of October 26, 1987, "B" core spray pump motor was disassembled and the surge ring brackets inspected by G.E. Due to the geometry of the core spray pump motor internals, there is limited access for the bore scope, therefore, this inspection could not be accomplished without partial disassembly of the motor. It was verified that the design had 12 brackets per surge ring and two surge rings for the top end turn assembly and two surge rings for the bottom end turn assembly. None of the brackets had indications of cracking. The licensee scheduled the inspection of the "A" core spray pump motor during the next outage because of scheduling conflicts. The licensee indicated that based on the inspection

results of the RHR and "B" core spray pump motors, postponement of the "A" core spray pump motor inspection is justified. The licensee also added that the number of operating hours and starts are similar between the A and B core spray pump motors since both core spray systems' testing and surveillance requirements are similar. The inspector had no further questions. This item is closed.

(Closed) Unresolved Item 87-45-05 - Failure to Issue Licensee Event Reports

In inspection report 50-293/87-45 the NRC identified three engineered safety feature actuations which appeared to be reportable under 10 CFR 50.73 but had not been reported by the licensee. The licensee reviewed the three actuations, agreed that they should have been reported and agreed to issue License Event Reports (LER) to document the occurrences. In addition the licensee agreed to perform a review of previous actuations to determine if any additional reports were needed.

During this inspection period the licensee's compliance section conducted a review of all Failure and Malfunction Reports (F&MR) issued from April 1986 through the present. This review identified four F&MRs that fit the description of an ESF actuation under the current BECo interpretation of NUREG 1022. The licensee will submit LERs to document the following ESF actuations at a later date.

-- 4/28/87 Initiation signal to both Emergency Diesel Generators (EDG)

-- 6/7/87 Actuation of Reactor Building Isolation and Standby Gas Treatment System start signal

-- 9/17/87 Auto start of "A" EDG

-- 10/6/87 Reactor Water Cleanup and Shutdown Cooling System Isolation

These LERs will be reviewed upon issue as part of the normal resident inspection program. The inspector has reviewed the licensee's actions in addressing open item 87-45-05 and is satisfied that those actions were thorough and timely. This item is closed.

3.0 Routine Periodic Inspections

The inspectors routinely toured the facility during normal and backshift hours to assess general plant and equipment conditions, housekeeping, and adherence to fire protection, security and radiological control measures. Inspections were conducted between 10:00 p.m. and 6:00 a.m. on January 17, 18, and 19, 1988 for a total of four hours and during the weekends of December 12, 19, 27, 1987 and January 3, 9, 17, 1988 for a total of 17 hours. Ongoing work activities were monitored to verify that they were

being conducted in accordance with approved administrative and technical procedures, and that proper communications with the control room staff had been established. The inspector observed valve, instrument and electrical equipment lineups in the field to ensure that they were consistent with system operability requirements and operating procedures.

During tours of the control room the inspectors verified proper staffing, access control and operator attentiveness. Adherence to procedures and limiting conditions for operations was evaluated. The inspectors examined equipment lineup and operability, instrument traces and status of control room annunciators. Various control room logs and other available licensee documentation were reviewed.

The inspector observed and reviewed outage, maintenance and problem investigation activities to verify compliance with regulations, procedures, codes and standards. Involvement of QA/QC, safety tag use, personnel qualifications, fire protection precautions, retest requirements, and reportability were assessed.

The inspector observed tests to verify performance in accordance with approved procedures and LCO's, collection of valid test results, removal and restoration of equipment, and deficiency review and resolution.

Radiological controls were observed on a routine basis during the reporting period. Standard industry radiological work practices, conformance to radiological control procedures and 10 CFR Part 20 requirements were observed. Independent surveys of radiological boundaries and random surveys of nonradiological points throughout the facility were taken by the inspector.

Checks were made to determine whether security conditions met regulatory requirements, the physical security plan, and approved procedures. Those checks included security staffing, protected and vital area barriers, personnel identification, access control, badging, and compensatory measures when required.

a. Surveillance Testing

-- Diesel Generator Prelube Pump Failure

On December 13, 1987, the prelube pump for the "B" emergency diesel generator (EDG) failed to restart on demand during a routine surveillance test. Upon disassembly it was identified that a small piece of metal had become lodged between the pump rotor and idler gear. The interference from the metal caused the pump motor breaker to trip on pump start. An identical failure occurred during a loss of offsite power event on November 12, 1987. In that case the failure caused a lengthy delay in returning an idle diesel to service. While not required for diesel operation, the prelube system reduces EDG bearing wear during equipment start.

In response to the failures, the licensee drained and inspected the lube oil sump, and disassembled and inspected the lube oil filters, strainers and heater. The lube oil heater was found to have failed in the energized mode resulting in significant carbon deposits in the heater and filter. No appreciable deposits were found in the lube oil sump. In addition, a piece of filter element packaging material was found in the lube oil filter housing. No foreign material which could have contributed to the prelube pump failure, however, was found. The pump was replaced and the diesel was returned to service. No additional failures occurred during the inspection period. The two pumps which failed had in-sequence serial numbers. Licensee Quality Control personnel performed magnetic particle and dye-penetrant testing of the internals of a third in-sequence pump in the warehouse. No flaws were noted. The licensee is pursuing the root cause of the failures in cooperation with the pump vendor, Viking Pump. The licensee stated at the exit interview that the "A" EDG prelube pump and lube oil heater would be inspected during the next "A" diesel outage. The inspector will continue to monitor licensee followup to this problem.

- Steam Testing of the High Pressure Coolant Injection and Reactor Core Isolation Cooling Systems

The licensee completed full pressure steam testing of the High Pressure Coolant Injection (HPCI) and Reactor Core Isolation Cooling (RCIC) system turbines by utilizing temporary oil fired auxiliary boilers as a source of non-nuclear steam. The full pressure steam testing is part of a post-maintenance and system operability check. Both HPCI and RCIC systems were overhauled during the current outage. Utilizing temporary test procedures TP 87-198 and TP 87-199, the HPCI/RCIC testing included turbine overspeed trip, pump full flow capacity and operation from the alternate shutdown panels. Also during the test, the suction path was changed from the condensate storage tank to the torus and back.

During the testing, several problems were identified by the licensee in both HPCI and RCIC systems. In HPCI, problems with the governor control system were noted including a minor oil leak in the servo-motor. Steam leaks at gauges and turbine drain line were also discovered. In RCIC, the licensee discovered a previously installed blank flange in the turbine steam leak off line which caused steam leaks. A few problems were also noted on the RCIC governor control system. The licensee is in the process of dispositioning these items. The inspector noted that using non-nuclear steam for the testing enabled the licensee to discover problems which may not have been easily identifiable using nuclear steam due to the radiological conditions. The inspector will review the results of the tests and dispositioning of the problems identified during the tests.

- Incorrect Installation of Fire Dampers

On December 17, 1987, during performance of a routine surveillance test the licensee inadvertently actuated two fire dampers. One of the dampers failed to fully close due to interference with a hook used to secure it in the open position. When the fusible link was energized, the metal damper retaining strap should have fallen away allowing full closure. The hook attaching the strap to the fusible link was oriented with the open side toward the damper. The damper caught on the hook and remained partially open. Upon discovery the licensee immediately stationed fire watches at all areas containing suspect dampers. Inspections were promptly conducted and it was identified that all of the installed hooks were oriented in this manner. The hooks were repositioned so that the open side faces away from the damper. Three dampers were inaccessible and compensatory measures remain in place pending inspection.

The dampers were originally supplied to the licensee without the hooks. A revision to the plant design change (PDC) package added the hooks to facilitate surveillance testing. Installation instructions contained in the PDC specified hook orientation with the open side toward the damper. The vendor data sheet supplied by Air Balance Inc. also showed the hook installed in this manner.

Licensee event report (LER) 87-020-00 was issued describing the problem and corrective actions taken. The LER states that preliminary licensee assessment of the issue determined that it did not meet the reporting threshold of 10 CFR Part 21. The inspector discussed the Part 21 reportability with the licensee's Nuclear Engineering Department (NED). NED personnel stated that the failure mechanism was created by the licensee when the hook was added. In addition the presence of mitigating factors such as fire detection and suppression, and control of combustible materials support the conclusion that a substantial safety hazard did not exist. The licensee also feels that LER 87-020-00 contains sufficient information to clearly define the problem. The inspector had no further questions in this area.

The inspector examined two dampers in the cable spreading room to verify that the hooks had been reoriented. Both hooks had been modified, however, neither of the dampers had locking rings installed at the hook to retaining strap connection as required by the installation instructions in the PDC. The licensee reviewed the function of the locking rings and concluded that they were not required. A change to the PDC was initiated to delete the ring. The inspector had no further questions.

b. Radiation Protection and Chemistry

- Locked High Radiation Area Access Control

During the period covered by inspection report 87-57, four instances occurred in which the licensee failed to properly control access to areas that had been designated as locked high radiation areas. In three of these cases, doors to locked high radiation areas were found closed but not locked and in the fourth case a door into a locked high radiation area was found to not be on the list of doors that were being controlled under the locked high radiation area door procedure.

On December 15, 1987, a contract painter failed to check that the door to the locked high radiation area he was exiting was properly latched. The unlatched door was identified during the next routine check of high radiation area doors. Licensee personnel immediately latched the door and initiated a radiological occurrence report (ROR) to document the occurrence and track all actions taken during the investigation. Surveys of the area showed no dose rates greater than 1000 millirems per hour (MR/hr). Interviews with the individual involved determined that the procedures and requirements were well understood and that the HP technician had informed them of their responsibilities prior to entry into the area.

On December 27, 1987, and again on January 8, 1988, instances similar to the one described above took place. In both cases the licensee initiated RORs and took steps to determine: 1) who had been in the area, 2) were they aware of the procedure, and 3) had they been properly briefed prior to entry into the areas involved. In both of these cases the root cause has been determined as personnel error.

In one instance the licensee identified that one of the multiple doors into an area classified as a locked high radiation area was not on the list of doors to be checked on a routine basis. The door was immediately checked and found to be locked. Records have been audited to determine if any unauthorized entry into the area had occurred and no instances were identified. The door has been placed on the list and is now routinely checked.

The inspector reviewed licensee actions as a result of these instances and is satisfied that in all cases, the immediate and followup actions were timely and complete. Surveys taken were comprehensive and conducted almost immediately after discovery of unlocked areas. Dose calculations were performed and dosimetry read in all cases. Involvement by senior HP and plant management was evident in all instances.

Inadequate control of locked high radiation areas has been an area of longstanding NRC concern. Notices of Violation have been issued in the past, during inspections 50-293/87-03, 50-293/87-11, and 50-293/87-19 which addressed these concerns. In regard to these violations the licensee instituted corrective actions which have been successful in addressing segments of the problem but have not been successful in preventing recurrence of events involving high radiation area door control.

The inspector has independently reviewed the licensee's program for control of high radiation areas and high radiation area key control and has found them adequate. Although the programs themselves are adequate and personnel have been trained on those programs, instances still occur where locked high radiation areas are not adequately controlled.

Based on review of these four instances coupled with the review of Unresolved Item 87-50-08, the inspector determined that the licensee actions in response to these previous findings have not prevented recurrence. Failure to comply with the requirements of Technical Specification 6.11 and Implementing Procedure 6.1-012 is an apparent violation of NRC requirements as documented in Appendix A of the cover letter to this report (87-57-01). Licensee response to Appendix A should include those measures taken to insure that corrective actions are effective and lasting.

- Contaminated Clothing Offsite

On December 17, 1987, at 7:26 p.m. hours a Bechtel pipefitter who was exiting the reactor building, set off a whole body portal monitor alarm. The portal monitor indicated contamination of his chest area and left hand. The health physics technician on duty at the access point removed the individual from the portal monitor and began performing a survey using a RM-14 with DT 260 probe. The HP technician identified; 1) contamination on the individual's left hand, 1-2 thousand dpm per 100 square centimeters (K DPM), which was removed by washing, 2) contamination on the shirt in both the chest (80K DPM) and lower stomach area (1K DPM). The shirt contamination was removed by tape (80K DPM) and washing with soap and water (1K DPM). The employee, now wearing an undershirt and trousers, was then sent to clear the portal monitor which again alarmed and indicated contamination in the chest area. The HP technician again surveyed the individual and identified contamination on the undershirt in the chest area (70K DPM). The individual was then sent into the portal monitor bare chested and was cleared. The individual was given his outer shirt, which was still wet from decontamination and cleared through portal monitor. At this point, the individual removed the wet shirt, put on his jacket, cleared the portal monitor again, and left for his home.

Upon returning to work December 18, 1987, the individual was given a whole body count to determine if any internal contamination had occurred. The whole body count showed no internal contamination. After completion of the whole body count the individual was interviewed to determine how he had been contaminated, where the occurrence took place and how long he was contaminated prior to detection, to calculate skin dose received.

The interview revealed that the individual had been contaminated when he disconnected a partially pressurized service air hose and depressurized it. The interview also revealed that the individual used the portal monitor at the 91 ft. elevation of the reactor building, received an alarm, did not call for HP assistance but instead tried to decontaminate himself prior to proceeding to the reactor building access. Station procedures require that an individual who finds himself contaminated is to call health physics for assistance. The individual stated that he was aware of this requirement. During the interview the individual expressed concern about whether his heavy winter jacket could have shielded the contamination on his shirt and undershirt from detection by the portal monitors. To demonstrate that this could not happen, a HP supervisor placed plastic bags, which contained the contamination removed from his shirt, inside the coat and attempted to exit through two portals. The portal monitors alarmed on each attempt. The individual appeared satisfied with the demonstration put his jacket back on, with the plastic bags removed and attempted to leave the reactor building. An alarm was actuated on the portal monitor and contamination was indicated on the left arm. The on duty HP technician removed the individual from the portal monitor and identified 3K DPM contamination on the upper right sleeve (outside) of the jacket even though the jacket had not been worn into the reactor building. At this juncture the individual expressed concern over whether the shirt that he had worn the previous day could still be contaminated. The licensee had a HP technician accompany the individual to his home. The individual's shirt was found to be contaminated, was bagged and returned to the site. Surveys of the individual's home and vehicle identified no further contamination.

Efforts to determine how the contaminated shirt was worn through the portal monitors without setting of an alarm yielded positive results. The individual stated that he had purposely kept himself away from the portal monitor in an attempt to keep his wet shirt away from his skin. The licensee taped the plastic bags, with the contamination in them, back onto the shirt and an HP supervisor attempted to pass through the portal monitors by

mimicking the body posture used by the individual when he cleared the monitor. The HP supervisor was able to pass through six different monitors without setting off an alarm. The HP supervisor then used the portal monitors in the correct manner and all six monitors alarmed proving that the equipment was functional.

The licensee has evaluated the occurrence to identify the root causes and immediately implemented corrective action. This occurrence was caused by one sequence of events that involved two distinct personnel errors. The primary cause involved the failure of the HP technician to perform an adequate survey of the contaminated individual's clothing when the portal monitor alarm was received. The second problem involved the failure to properly use the installed portal monitors at the reactor building access.

In addition to personnel interviews to identify the sequence of events the licensee also reviewed procedural adequacy, personnel training and portal monitor calibration and performance. These reviews verified that training was adequate and portal monitor performance was as designed. Procedures for control of contaminated individuals at the reactor building access did not specifically require that all articles of clothing require a 100% frisk prior to this occurrence. Instructions have been posted at the reactor building access which now clarify the procedure to be followed when an individual is found to be contaminated.

The portal monitors in use at Pilgrim do not presently have a switch at chest level which must be actuated to start the monitoring process. Lack of this feature allowed the individual wearing a contaminated shirt to lean away from the machine sufficiently to clear the monitor without any alarm. The licensee has determined that the manufacture of the portal monitor now produces a chest high switch for the installed model and will install them in the future.

Calculations have been performed by the licensee to determine the radiation dose received by the individual and the amount of radioactive material that was released from the site on the contaminated shirt. The results of these calculations show that the individual received a localized radiation dose to the skin of 260 MRem, which is below the federal limits for skin exposure, and that the amount of radioactive material on the individuals clothing was 0.2 microcuries which meets the federal criteria as an exempt quantity of Co-60. The inspector is satisfied with the licensee's analysis and corrective actions and has no further questions.

- Allegation of Improper Disposal of Radioactively Contaminated Shrubs (RI-87-A-0107)

On August 31 and September 11, 1987, the NRC resident office at Pilgrim received allegations that radioactively contaminated shrubs had been removed from the site and improperly disposed. The alleged improper disposal occurred on July 23, August 26 and August 28, 1987. During this time period the licensee removed a large number of shrubs from various areas of the site, including those planted near the old administration building and the switchyard. The shrubs were removed to facilitate site construction activities and to alleviate certain security concerns. Upon receipt of the first allegation on August 31, 1987 the NRC requested that the licensee perform an evaluation and provide the results for review. In addition an independent NRC review was initiated.

Resident and specialist inspectors reviewed the licensee's conclusions. The licensee evaluated material release records and interviewed personnel regarding removal of shrubs during the week of July 20, 1987. Several truckloads of shrubs that were transported offsite during the midnight shift on July 24 were examined in detail. Because trace amounts of Cobalt-60 had previously been found in soil onsite, some of the shrubs had the soil removed from the roots prior to release. Each shrub was hand surveyed and found to meet established offsite release criteria. They were transported first to the licensee's shorefront area and later to a dump site on licensee property. The licensee concluded that the shrubs had been adequately surveyed and that no radioactive material had been improperly released.

The resident inspectors reviewed the licensee's program for control of release of material from the site. This area was also evaluated by NRC specialist inspectors during inspection 50-293/87-19. Both inspections concluded that appropriate surveys and release limits have been established and implemented. Resident and specialist inspectors examined licensee release records for the dates in question to verify that vehicles leaving the protected area had been properly surveyed. No discrepancies were identified. An NRC resident inspector accompanied by a licensee representative collected four samples of the shrubs which had been deposited in the dump site discussed above. Each of the four samples consisted of root, branch and foliage clippings from a number of different shrubs. The samples were independently analyzed by the NRC. Three of the samples indicated no contamination. One sample indicated only trace levels of Cobalt -60. Measurements showed that the amount of CO-60 present in this sample was about 2% of the average radioactivity typically found in soil due to naturally occurring isotopes.

The licensee's program for release of material from the site appears adequate. Appropriate survey techniques and release limits have been established. Review of records confirmed that the program is being implemented. Samples of the shrubs collected by the NRC showed zero or negligible contamination and pose no health and safety concern. Based on the above this allegation is considered closed. NRC Region I staff provided status briefings concerning this allegation to Senator Kennedy's staff and to the Massachusetts Department of Public Health.

- Allegation of Airborne Radioactivity in the Trash Compaction Facility (RI-87-A-0120)

On October 5, 1987, the resident office received an anonymous allegation that personnel working at the sort table in the trash compaction facility (TCF) were being routinely exposed to airborne radioactive contamination. The alleger stated that the two filter systems designed to treat exhaust air from the sort table prior to discharge into the room were not functioning, and that the filter differential pressure alarm circuits had been disabled.

On October 7 and 8, 1987, NRC specialist inspectors toured the TCF and examined the design and condition of the equipment. The sort table is used to separate contaminated materials for compaction and disposal. Potentially contaminated air is exhausted from the table, passed through two filters operating in parallel, and released into the room. Airborne radiation levels in the room are measured by means of a separate air monitor which is operated whenever the sorting table is used. The alarm is typically set at 3 X 10 -10 (3E-10) microcuries per cubic centimeter (cc). In addition the filters are surveyed daily and changed if contact dose rates exceed 2mR per hour. The inspectors also examined the trash compaction unit in the area and found that similar controls had been applied. Based on the above, no immediate health and safety concerns were indicated.

On January 15, 1988, the resident inspectors toured the TCF, examined equipment operation and interviewed licensee and contractor personnel involved in ongoing work activities. A radiation work permit specifying protective clothing, health physics coverage, and use of a continuous air monitor is in place to control work at the sort table. Personnel involved stated that trash bags were surveyed prior to sorting and rejected if radiation levels exceeded 5mr/hr, if they contained liquid, or if any powdery material was present. The health physics technician on duty stated that filter radiation levels are monitored daily.

Workers and health physics personnel also stated that filter differential pressure (dp) instruments are monitored to detect filter plugging, however no one had been clearly assigned this responsibility and no dp limit was established. The inspector observed the operation of the table and noted that the "filter restricted" alarm actuated for one of the two filters. The alarm actuated for the filter displaying the lower differential pressure. When questioned workers stated that much of the monitoring and alarm circuitry for the table was not functional, and that the filter alarm was not reliable. The table was originally part of a larger processing system and much of the disconnected circuitry was intended to perform functions which are no longer needed. The inspector verified that current filter dp readings are consistent with the manufactures name plate data.

It appears that the general process applied, including inspection and survey of trash bags prior to sorting, daily filter surveys and continuous air monitoring would preclude airborne radioactivity problems. Based on the above this allegation is closed. However, the inspector noted that no work instructions existed describing the controls applied and equipment monitoring requirements. When discussed with licensee radiation protection management they promptly committed to review the situation and issue appropriate guidance. This was confirmed during the inspector's exit interview.

- Erosion of Construction Dirt into Wetland

On January 15, 1988, at 5:45 p.m. the licensee made an ENS notification in accordance with 10 CFR 50.72 (b)(2)(vi) which requires the licensee to inform the NRC of an event or situation related to health and safety of public for which a news release was made or notification of another government agency has been made. During routine environmental monitoring, the licensee observed erosion from a pile of construction dirt into an adjacent licensee controlled wetland. The Plymouth Conservation Commission and the Massachusetts Department of Public Health were notified and the press release was made by the licensee. Also on January 16, 1988 two representatives from the Plymouth Conservation Commission toured the area.

In the last several years during onsite excavation for plant modifications, dirt, asphalt and concrete containing low levels of contamination were stored in a fenced in storage area outside the protected area or the licensee's property. The licensee estimated that the storage area contains 110,000 cubic feet of material. Before removal from the protected area, samples of

material were obtained and isotopic analyses was performed by the licensee. The activity found was reasonably uniform at levels of 10(1E-6) and 10(1E-7) microcuries of Cobalt-60 and Cesium-137 per gram. Sampling and storage of this material was previously reviewed during inspection 50-293/87-18. On January 21, 1988 the inspector toured the area, accompanied by a licensee health physics technician, and performed a survey of the storage area and found no detectable radiation above background levels. During the tour the inspector noted that bales of hay had been put around the perimeter of the fence which borders wetlands area to prevent further erosion of material. The fenced in storage area was secured with a locked gate. The inspector's survey of the area and review of licensee's analyses indicate that the level of activity does not represent a health or safety concern. However, the inspector raised a concern to the licensee management that the material should not be allowed to erode. The inspectors will continue to monitor the licensee actions in formulating long term solution to properly dispose of the material.

c. Fire Protection

On January 17, 1988, at 4:55 a.m. the control room received a report from a security guard of smoke coming from a contractor lavatory trailer, which is located adjacent to the Bechtel warehouse inside the protected area fence. The onshift fire brigade chief was dispatched to the scene and confirmed smoke and smoldering in the area. The fire brigade was immediately dispatched and fire was extinguished using a portable dry chemical extinguisher and a hose from a nearby hydrant house. Electrical maintenance was called to shut off the power to the trailer. By 5:30 a.m., the fire brigade members had cleared the scene and a continuous fire watch was posted in the area. The cause of the fire was believed to be overheating of an overhead heating unit for the trailer. No personnel injury occurred. The inspector toured the scene with a licensee fire protection engineer on January 18, 1988. Minor damage to a small area of the ceiling in the trailer was observed. The Plymouth Fire Department was notified by the licensee in the morning of January 18, 1988.

4.0 Review of Plant Events

The inspectors followed up on events occurring during the period to determine if licensee response was thorough and effective. Independent reviews of the events were conducted to verify the accuracy and completeness of licensee information.

a. Spurious Isolations of RHR Shutdown Cooling System

On December 7, 1987, at 2:28 p.m., an inadvertent isolation of both inboard and outboard containment isolation valves on the RHR shutdown cooling suction line occurred. Preparation for the reactor vessel hydrostatic test was in progress. As part of the hydrostatic test procedure, a technician was installing an electrical jumper in the primary containment isolation system logic panel C-941 to bypass the reactor coolant system (RCS) high pressure interlock on the inboard isolation valve. When the termination screws were loosened to install the jumper, the leads lost contact and caused a false high pressure isolation signal. RHR was in its shutdown cooling mode when the isolation signal was generated, and the shutdown cooling suction valves (MOV 1001-47, 1000-50) automatically closed as designed. Coincident with the closure of the valves, the "A" and "C" RHR pumps tripped automatically to protect the pumps from loss of adequate suction. The licensee determined the actuation was due to a personnel error. The licensee revised Procedure 2.1.8.1, Class I System Hydrostatic Test, to caution the I&C technician of potential isolation of RHR shutdown cooling system while installing the jumper.

On December 8, 1987, at 9:45 p.m., the inboard isolation valve (MOV 1001-50) on the RHR shutdown cooling suction line automatically closed. The automatic isolation occurred when the plant reached 100 psig during pressurization for performance of the class I hydrostatic test. The outboard isolation valve (MOV 1001-47) was already closed to form a pressure boundary for the test. The licensee's investigation determined that the cause of the isolation was that Procedure 2.1.8.1 did not identify all the jumpers necessary to bypass the RCS high pressure interlock on the inboard isolation valve.

As immediate corrective action, the licensee halted the pressurization of RCS and reviewed the logic prints. The licensee revised Procedure 2.1.8.1 to reflect the need to install an additional jumper in panel C-942. In reviewing this event along with other similar events documented in previous inspection reports, the inspector noted that inadequate planning and inadequate procedures appear to be a common root cause for several ESF actuations which occurred on September 17, September 22, October 15 and October 24, 1987. The inspector expressed this concern at the exit meeting with licensee management. The licensee informed the inspector that the Technical Group is in the process of developing generic guidance for isolating or jumpering an electrical component which may cause inadvertent safety system actuations. The inspector will continue to monitor the effectiveness of licensee's corrective action to prevent further ESF actuations due to inadequate planning and inadequate procedures.

b. Reactor Water Cleanup System Spurious Isolation

On December 17, 1987, at 11:05 a.m., the inboard primary containment isolation valve on the reactor water cleanup (RWCU) system suction line automatically isolated. I&C technicians conducting a routine surveillance of the RWCU high area temperature isolation logic inadvertently grounded a lead which had been lifted during the test. Grounding the lead resulted in a blown logic power fuse and isolation of the valve (MOV 1201-2). Following investigation by the control room supervisor, the fuse was replaced and the isolation was reset. The licensee's investigation concluded that the root cause is a personnel error. The licensee informed the inspector that the procedure, 8.M.2-1.2.2, Reactor Water Cleanup Area High Temperature, will be revised to provide cautions to the control room operators and the I&C technicians. Also, an effort is ongoing to review recent ESF actuations caused by personnel error to formulate appropriate corrective actions.

c. Engineered Safety Feature Actuations Due to a Failed Logic Relay

On January 6, 1988, at 2:50 p.m., the coil of primary containment isolation system (PCIS) electrical relay 16A-K57 failed, creating a fault and resulting in blown logic power fuses. The deenergization of this portion of the PCIS logic caused a partial primary containment isolation along with a reactor building isolation and start of the "B" Standby Gas Treatment system (SBGT). The licensee notified the NRC at 5:12 p.m. via ENS. The failed relay was a GE type CR120A relay. The licensee has experienced several failures of this type of relay in the last few years. The licensee's evaluation of this high failure rate and corrective actions to address it are described in the inspection report 50-293/87-50.

On January 7, 1988, the inspector reviewed maintenance request (MR) 88-9 which had been initiated to investigate the cause of the above mentioned ESF actuations and to replace the blown fuse and the faulty relay. The inspector noted that the relay replacement was performed using only procedure 3.M.1-11, Routine Maintenance. This procedure contains general guidance and its stated use is for performing maintenance activities which are not complicated or critical enough to require detailed written procedures. In this case, no step-by-step instruction was initiated to control the sequence of work, to control and tag lifted leads and jumpers, and to ensure verification and independent verification of system restoration. A similar problem involving lack of a sufficiently detailed controlling procedure and the appropriate reviews during an electric relay replacement on November 24, 1987 was the subject of a violation as documented in the inspection report 50-293/87-50. The licensee informed the inspector that the corrective actions to address the violation are being formulated and will be submitted to the NRC.

c. Spurious Reactor Protection System Actuation

On January 17, 1988, at 1:13 a.m., a spurious reactor scram signal was generated during the performance of a reactor level instrument calibration. The full scram signal on low water level was received due to a disturbance in the reactor water instrument line when an I&C technician was valving a level instrument (LI-263-59A) back in service. The Rosemount level transmitters (LT-263-57 A&B) which initiated the scram signal are on the same instrument rack. The licensee's preliminary investigation indicated that the root cause of the event is attributed to a combination of personnel error and inadequate procedure. The investigation also identified that the level instruments (LI-263-59 A&B) were incorrectly installed in that the sensing lines were reversed. The new Barton level instruments (LI-263-59 A&B) were recently installed during this outage and would only be used for local indication during a shutdown from outside the control room. The licensee is currently reviewing the plant design change (PDC 85-07) records and post-installation test data to determine the cause. Surveillance test records are also being reviewed by the licensee. This item is unresolved pending the completion of the licensee investigation (87-57-02).

Upon receiving the spurious scram the control room staff noted that scram discharge instrument volume (SDIV) vent valve CV302-23B primary containment vent and purge valves AO5044B and AO5035B and one of two redundant secondary containment isolation dampers in each line did not close. In addition the "B" standby gas treatment system (SGTS) did not start. Based on the initiating event, these components should have actuated. The licensee notified the NRC of the failures via ENS at 5:00 a.m. on January 17, 1988.

The control room staff conducted an immediate critique with available I&C personnel, and documented observations for management followup. Later on January 17, the licensee inspected the physical condition of the SDIV vent and drain valves and noted paint on the stem of CV302-23B. The paint was removed and the valve successfully stroke timed. The licensee held a second critique with management representatives on the morning of January 18, 1988 to assess the situation. Subsequently, a walkdown of involved isolation logic components was performed to verify relay contact configuration and to identify any jumpers or lifted leads. This walkdown was performed to the extent possible without disturbing components. No discrepancies were noted. Early on January 19, the licensee performed a test in which a reactor scram was intentionally initiated. The same equipment failed to actuate as during the January 17 scram. Based on this licensee management stopped all work on the affected components. A task force composed of members from the technical staff, systems group, I&C and operations was designated to investigate the incident. This team reviewed available information and developed an action plan.

Walkdowns of the air system piping and components supplying motive air to SDIV vent valve CV302-23B were performed to verify that the as built configuration is in accordance with design documents and that components are in good physical condition. No discrepancies were identified. Valves CV302-23B and CV302-22B are supplied air by the same solenoid operated valves. The licensee deenergized these solenoid valves and observed that CV302-22B closed while CV302-23B did not. This indicates a mechanical problem with the valve or operator. The licensee was identifying replacement parts and preparing to disassemble the valve by the close of the inspection period. The inspectors will continue to monitor licensee followup to this failure.

Licensee review of logic drawings confirmed that the remaining equipment which had not properly actuated shared common isolation logic components. A series of surveillance tests was performed to allow monitoring of key relay actuations. A single contact on a General Electric (GE) HFA relay was determined to be misfunctioning. The contact is required to close when an isolation signal is received, actuating the affected equipment. However, contact resistance remained high with the contact closed. The relay was replaced and the system successfully tested. The licensee contacted GE to coordinate disassembly and inspection of the relay. Dissassembly had not begun by the close of the inspection period. The inspector will continue to monitor licensee investigation of this failure.

The inspector expressed concern that three separate equipment malfunctions had occurred during the inadvertent actuation. This may reflect weakness in the surveillance and post-work test program. However, the licensee's response to the actuation and subsequent malfunctions was prompt, thorough and effective. Control room operators quickly recognized each of the failures. They held a critique on the same shift with involved personnel. Critique observations were clearly documented and provided to management. An additional critique with management present established priorities. Action was taken to freeze equipment until an investigation plan could be developed and implemented. Followup was well coordinated and involved representatives of several portions of the organization. In this case licensee commitment to determining and correcting the problem root cause was evident.

5.0 Review of Reactor Vessel Hydrostatic Test Procedure and Test Results

During the inspection period the licensee completed the reactor vessel hydrostatic test. Several reactor vessel instrument nozzles were repaired during this outage, prompting performance of a hydrostatic test rather than a system leakage test. The reactor vessel reached minimum test pressure and all inspections were completed on December 9, 1987. Only minor leakage associated with mechanical connections, such as flanges and valve packing was identified. The reactor vessel was depressurized on December 12, 1987 after completion of excess flow check valve testing.

The inspector reviewed the licensee's hydrostatic test procedure to verify that appropriate prerequisites, precautions and instructions had been included. A sample of valve lineups was reviewed to determine the adequacy of established test boundaries. Completed valve lineups were also examined. Control of temporary electrical and mechanical jumpers was evaluated to ensure proper documentation and restoration. The inspector observed installed pressure instrumentation and verified appropriate range and calibration status. The adequacy of staffing to support test performance was periodically verified. The inspector reviewed test results and discussed them with engineering, operations, and quality control personnel to ensure that test changes were properly processed, adequate inspections were conducted, and that inspection results were promptly dispositioned.

The licensee's preparation for and execution of the test was generally well organized and controlled. Procedures for test performance and conduct of visual inspections were clear and comprehensive. A detailed Quality Control (QC) work instruction was developed specifying components and piping requiring inspection. Inspection assignments were broken down by location, elevation and component. This QC instruction also included a series of piping diagrams depicting the test boundaries which were utilized to assist in inspection performance and documentation. The licensee's Technical Engineering Section, Quality Control staff and Nuclear Engineering Department each reviewed test boundary adequacy. Inspection results were well documented, and maintenance requests were promptly initiated to correct identified leakage.

The licensee experienced two shutdown cooling isolations during implementation of the test procedure. These isolations are discussed in detail in section 4.a of this report. During the test the licensee identified leakage past the seal ring at the stuffing box to pump casing joint on both recirculation pumps. Leakage flow was estimated to be one to two gallons per minute for each pump. The leakage wet the pump casings and portions of the suction piping, and acceptable inspections could not be completed in these areas. The licensee stated that similar leakage on at least one of the pumps was noted during the last outage. That leak sealed as system temperature increased during startup. The licensee believes that the leakage observed during the recent test will also stop as temperature is increased, and no pump repairs are planned. The licensee stated at the inspector's exit interview that the pump casings and suction piping will be reinspected during startup.

The inspector noted that the test procedure did not contain valve lineups for manual instrument isolation valves within the test boundary. Many instruments and a significant portion of instrument piping has been replaced this outage. Visual inspections were performed of class I piping downstream of these valves. The inspector questioned the basis for licensee confidence in instrument line isolation valve positions during the test. The licensee pointed out that hydrostatic testing of these lines was not required during this outage. In addition excess flow check valve

testing was conducted immediately after completion of the hydrostatic test with the system still pressurized. Successful completion of the check valve testing requires proper alignment of the manual isolation valves, and provides assurance that the piping was pressurized during the visual inspections. The licensee however, agreed that the intent of the test had been to pressurize and inspect this piping and that the current procedure does not adequately assure the correct valve alignment. Licensee management stated that the procedure would be revised to address this weakness.

6.0 Integrated Leak Rate Testing

On December 21, 1987, the licensee began performance of the primary containment integrated leak rate test (ILRT). The containment was pressurized with air to the full test pressure of 45 pounds per square inch and maintained at this pressure for 24 hours. The 24 hour test period started at 10:15 p.m. on December 21, 1987. A regional specialist inspector was onsite during the ILRT to review the adequacy of the test procedure and to observe the conduct of the test. The preliminary licensee test results indicated a successful test, with measured leakage slightly greater than 20 percent of the allowable leakage. A primary contributor to the observed leakage was identified as a drywell pressure transmitter piping cap which had not been fully tightened. Upon completion of the specialist inspector's review of the ILRT results, inspection report 50-293/87-58 will be issued documenting the inspectors findings.

While preparing for the primary containment integrated leak rate test (ILRT) the licensee observed that several torus temperature and moisture elements were not functioning properly. Troubleshooting identified circuit faults at a torus electrical penetration assembly. The licensee removed the penetration assembly protective cover inside the torus and found that it was filled with water. The penetration is installed vertically through the top of the torus. On both the inboard and outboard sides of the penetration a metal frame is attached on which 28 terminal boards are mounted. Cables passing through the penetration, and supplying instrumentation in the torus also landed on these terminal boards. A protective cover is bolted over the frame and terminal boards on both sides of the penetration. Design drawings specify that cover joints are to be sealed with silicone tape. The licensee stated that the protective cover had not been properly sealed, allowing water intrusion and buildup. The water caused significant corrosion of the cable connectors, terminal boards and metal framework. This corrosion and water buildup resulted in the observed electrical circuit faults. Licensee inspection of the other torus electrical penetration identified similar conditions. Temporary repairs of the temperature and moisture elements were made to allow ILRT performance. Cables for communications, lighting, and torus to drywell vacuum breaker indication also run through the penetration. The penetration is not considered by the licensee to require environmental qualification but is designated as a "Q" component. The licensee is evaluating the root cause of the water intrusion and is developing a temporary procedure to control repair and testing of the penetration. The inspectors will continue to monitor licensee followup and corrective actions.

The licensee informed the inspector that penetration repairs would not be completed until after ILRT performance. The inspector questioned the effect of the planned repairs on the penetration leak tightness, and the ability to perform adequate leakage test after the planned rework. The licensee stated that the work would not affect penetration leakage but that adequate testing could be performed after work completion. Based on available drawings however, the licensee could not demonstrate adequate testability. In response to NRC concern the licensee obtained the needed drawings from the vendor and verified that the penetration was completely testable. The inspector had no further questions.

During the ILRT, the licensee identified a water leak in the high pressure coolant injection (HPCI) turbine room. It was determined that the increasing pressure in the torus air space caused the suppression pool water to back up through the HPCI turbine exhaust line and through the drain piping, overflowing the HPCI gland seal condenser onto the HPCI room floor. The turbine exhaust line discharges to the torus through a check valve and a locked open stop-check valve. To prevent any condensation from collecting in the turbine exhaust line downstream of the check valve, a drain piping drains any condensation to the HPCI gland seal condenser through a drain pot. Two solenoid operated drain valves on the drain pot close automatically on a HPCI (Group IV) isolation signal. This is to provide the isolation from the torus to the gland seal condenser. The licensee's investigation determined that leads had been lifted in the HPCI isolation interlock logic circuit since October 30, 1987 in support of the HPCI steam testing utilizing temporary oil-fired auxiliary boilers. With the HPCI isolation signal bypassed, the drain valves remained open as the drain pot was filled with the suppression pool water. The licensee subsequently relanded the leads in the HPCI isolation interlock logic circuit and the drain valves closed.

After reviewing the ILRT procedure, HPCI test procedure and interviewing licensee personnel, the inspector concluded that licensee review of the active maintenance requests prior to the ILRT was not thorough in that the lifted leads controlled by the MR 87-663 were not identified. The MR tags were attached on the HPCI isolation logic circuit inside a logic panel and thus the tags were not identified during a system walkdown prior to the ILRT. The drain valve positions were verified by the light indications on the control room panel 903 as prescribed in the ILRT procedure.

The inspector also determined that the maintenance request above may not be an adequate method of identifying and tracking jumpers and lifted leads, especially for a long term application and for components which could affect other ongoing maintenance or surveillance. Station procedures do not require temporary modification controls for jumpers and lifted leads which are controlled by active maintenance requests. The inspector discussed these findings at the exit interview with licensee management. The licensee informed the inspector that a lifted leads and jumper log will be kept in the control room to aid the operators in controlling lifted leads and jumpers.

7.0 Licensee Nuclear Organization Management Realignment

On December 14, and on December 31, 1987, the Boston Edison Co. announced, as part of a planned realignment occurring over the next several weeks, the appointment of the following managers to key management positions in the licensee nuclear organization at Pilgrim Station.

-- Mr. Kenneth L. Highfill was named to assume the new position of Station Director. In this capacity, Mr. Highfill will oversee day to day operation of the Pilgrim Station including plant operations, planning and outage, nuclear training, plant support functions, and administrative services. Mr. Highfill will report directly to Mr. Ralph G. Bird, Senior Vice President-Nuclear.

-- Mr. Robert J. Barrett was named the new Plant Manager. Mr. Barrett will report to Mr. Highfill, the Station Director.

-- Mr. Roy Anderson, currently Deputy Outage Manager, was named to assume the new position of Planning and Outage Manager. Mr. Anderson will report to Mr. Highfill, the Station Director.

-- Mr. Ed Kraft was named to assume the new position of Plant Support Manager. In this capacity, Mr. Kraft will oversee radiological, security, industrial safety and fire protection, and other station support functions. Mr. Kraft will report to Mr. Highfill, the Station Director.

-- Mr. Donald Gillespie, currently Director of Planning and Restart, was appointed to the position of Quality Assurance Department Manager. Mr. Gillespie will assume the position after completing his Senior Reactor Operator training. The Quality Assurance Department Manager reports to Mr. J. E. Howard, Vice President-Engineering.

-- Mr. Frank Famulari, currently Operations Quality Control Group Leader, was named to assume the newly created position of Deputy Quality Assurance Department Manager. Mr. Famulari will report to Mr. Gillespie, and be acting Department Manager until Mr. Gillespie assumes the position after completing the Senior Reactor Operator training.

-- Mr. John F. Alexander was named to assume the position of Operations Section Manager. Mr. Alexander will report to Mr. Barrett, the Plant Manager.

-- Mr. Donald J. Long was named Security Section Manager. Mr. Long will report to Mr. Kraft, the Plant Support Manager.

8.0 Management Meetings

At periodic intervals during the course of the inspection period, meetings were held with senior facility management to discuss the inspection scope and preliminary findings of the resident inspectors. On January 26, 1988, the inspectors conducted a final inspection exit interview to formally present inspection findings.

Attachment I to Inspection Report 50-293/87-57

Persons Contacted

* R. Bird, Senior Vice President - Nuclear
* K. Highfill, Station Director
K. Roberts, Plant Manager
R. Barrett, Deputy Plant Manager
R. Anderson, Planning and Outage Manager
E. Kraft, Plant Support Manager
F. Famulari, Deputy Quality Assurance Manager
D. Swanson, Nuclear Engineering Department Manager
J. Alexander, Operations Manager
N. Brosee, Maintenance Manager
J. Jens, Radiological Protection Manager
J. Seery, Technical Manager
R. Grazio, Field Engineering Manager
P. Mastrangelo, Chief Operating Engineer
R. Sherry, Chief Maintenance Engineer
N. Gannon, Chief Radiological Engineer
D. Long, Security Manager
F. Wozniak, Fire Protection Manager

*Senior licensee representatives present at the exit meeting.

ATTACHMENT II

January 6, 1988

MEMORANDUM FOR: Ken Roberts
Plant Manager

FROM: Clay Warren
Senior Resident Inspector - Pilgrim

SUBJECT: FACILITY TOUR FINDINGS, DECEMBER 8, 1987

The items on the attachment were noted during the facility tour on December 8, 1987. Please contact the Resident Inspector Office when your staff is ready to discuss the evaluation of the items and the status of any actions taken. Please note the items and the facility response will be addressed in a routine inspection report.

Thank you for your time and attention to these matters.

Sincerely,

Clay C. Warren
Senior Resident Inspector

Attachment:
As stated

cc w/attachment:
R. Blough
W. Kane
W. Russell
J. Wiggins

ATTACHMENT

-- Numerous motors appear to have failed grease seals caused by overgreasing without first removing grease drains. This condition causes a buildup of grease and dirt in the cooling airflow path and in extreme cases grease in the motor windings. (SBGT fans and SLC pumps)

-- Nuts and bolts were noted laying inside an electrical cabinet in the RCIC room.

-- Multiple cases of open junction boxes, terminal boxes and conduit pulled away from terminal boxes were noted.

-- Motor heaters for the "B" RHR pump appear to have overheated causing the insulation on the heaters to melt.

-- HPCI room cooler drip pan is full of paint scrappings which could lead to drain clogging.

-- Standby Liquid Control system relief valves have boric acid crystal buildup which could alter setpoints.

-- Painting effort should be more closely controlled to prevent painting inappropriate surfaces, i.e., linkages, valve packing glands, trip throttle valves, limit switches, etc.

-- Numerous instances of scaffolding materials, i.e., nails and wood chips, laying on floors. This material could migrate to drain systems and cause pump or valve damage. Scaffolding was also noted attached to permanent equipment such as piping and conduit.

-- Valve 1001-36A motor operator conduit had melted plastic cover.

QUESTION 13. Has Pilgrim ever violated established radiation emission levels; i.e., have there been any releases from the plant which exceeded standards set by the NRC?

ANSWER.

The permissible levels of radiation in unrestricted areas and of radioactivity in effluents to unrestricted areas are established in NRC regulations embodied in 10 CFR Part 20, Standards for Protection Against Radiation. These regulations specify limits on levels of radiation and limits on concentrations of radionuclides in the facility's effluent releases to the air and water (above natural background) under which the reactor must operate. Further, the regulations require that there be no unmonitored release paths from the plant. The regulations are structured to provide reasonable assurance that no member of the general public in unrestricted areas will receive a radiation dose, as a result of facility operation, of more than 0.5 rem in 1 calendar year. These radiation-dose limits are established to protect the health and safety of the public.

In addition to the Radiation Protection Standards of 10 CFR 20, 10 CFR 50.36a establishes license requirements in the form of license Technical Specifications on effluents from nuclear power reactors. The purpose of the Technical Specifications on effluents is to keep releases of radioactive materials to unrestricted areas during normal operations, including expected operational

<u>QUESTION 13</u>. (Continued) 2

occurrences, as low as is reasonably achievable (ALARA). Appendix I of 10 CFR Part 50 provides numerical guidance on dose-design objectives for light water reactors to meet this ALARA requirement. The dose-design objectives are low, about 1% of the Radiation Protection Standards of 10 CFR Part 20. Thus, it is possible for a licensee to exceed the dose-design objectives, but still be within the Radiation Protection Standards.

The NRC staff has reviewed the agency records on radioactivity releases from the Pilgrim nuclear power plant. Although there were situations when the radioactivity releases exceeded Pilgrim's Technical Specifications, these releases did not exceed the Radiation Protection Standards of 10 CFR Part 20.

We have also reviewed the agency records on the amounts of radioactivity measured in the environment around the Pilgrim nuclear power plant. The licensee has reported elevated levels above normal background of some radionuclides in some environmental samples over the time period 1978 through 1981. However, it should be noted that Pilgrim's previous guidelines for reporting elevated levels of radioactivity in environmental samples were conservative. Under Pilgrim's current Technical Specifications, many (if not all) of the previously reported elevated levels would no longer be considered reportable. The previously reported elevated levels of radioactivity in environmental samples would lead to doses less than specified in the Radiation Protection Standards and thus would be below NRC regulatory limits.

EDWARD M. KENNEDY
MASSACHUSETTS

United States Senate
WASHINGTON, DC 20510

March 7, 1988

Mr. Richard Krimm
Assistant Associate Director
Office of Natural and Technological
Hazards Program
Federal Emergency Management Agency
500 C Street, S.W.
Room 630
Washington, D.C. 20472

Dear Mr. Krimm:

I would like to take this opportunity to thank you on behalf of the Senate Labor and Human Resources Committee for your participation in the hearing concerning the restart of the Pilgrim nuclear power plant in Plymouth, Massachusetts.

During your testimony, I asked if you would support a Congressional initiative aimed at providing FEMA with the authority to shut down or keep closed a nuclear power plant which did not have in place an approved emergency evacuation plan. Such authority would effectively change FEMA's role in emergency preparedness from advisory to regulatory. In response to my question, you requested additional time to prepare your answer for the hearing record. I would appreciate your response so that it may be included in the hearing record.

I have attached a list of additional questions which I would also like you to address for the record.

Again, thank you for your assistance. I look forward to your reply.

With best wishes,

Sincerely,

Edward M. Kennedy

enclosure

I. FEMA's Self-Initiated Review and Interim Finding for the Pilgrim Nuclear Power Station identified six areas of major deficiency in Emergency Preparedness. These areas were (1) lack of a reception center for people evacuating to the north; (2) lack of evacuation plans for public and private schools and daycare centers; (3) lack of identifiable shelters for the beach population; (4) inadequate planning for the evacuation of people with special needs; (5) inadequate planning for evacuation of the transport dependent population; and (6) an overall lack of progress in planning and in emergency preparedness. I would like to know in detail what progress has been made during the past six months to address these six areas of deficiency. What projections can FEMA make relative to the length of time it may require to remedy existing deficiencies in Emergency Preparedness? In your answer, please respond to the following:

(a) What new measures have been undertaken to ensure that the handicapped population has been identified, is adequately informed of what actions to take in an emergency, and is provided with transportation to leave the area, if necessary? Please include in your answer the specific procedures which will be followed for persons who are bedridden or in nursing homes and hospitals.

(b) Does FEMA believe that a third evacuation reception center is needed for people evacuating to the north? If so, has a center been selected or proposed?

(c) It is my understanding that bus transportation will be provided to evacuate public and private school children. I would be interested to learn what firms and/or school districts will be supplying the buses. Have written contracts been made with the bus companies to ensure their commitment? How many buses have been contracted? How many children attend public and private schools within a 10-mile radius of the plant?

(d) In relation to the beach population, it is my understanding that in the summer months, there are frequently hundreds, and sometimes thousands, of bathers at Duxbury Beach. The beach is 4½ miles long, it has only two small dwellings and a congested unpaved access road. I would like to learn what provisions are in place to ensure that the beachgoing population is protected by shelter in the case of a radiological emergency. I would like you to address the same question concerning the Plymouth town beach.

(e) What measures are proposed for dealing with the prison population at the Plymouth County House of Correction if events at Pilgrim warrant an evacuation?

II. In the case of the Chernobyl accident, an area significantly greater than ten miles was evacuated. Would FEMA support an increase in the Emergency Planning Zone around the Pilgrim plant which would encompass Cape Cod?

III. During adverse weather conditions, such as in the case of a severe snowstorm or during traffic tie-ups which occur during summer weekends, a great deal of additional time would be required for evacuation of the area. What assumptions does FEMA make concerning the affect of traffic and weather on an orderly and safe evacuation? Specifically, does FEMA base its Emergency Preparedness assessments on worst-case scenarios?

IV. You mentioned in your testimony that the FEMA Regional Office in Boston can expect to see a staff increase. When will this occur? How many people will be assigned to the Boston Regional Office in addition to the current staff (which you said numbered six people)? What are the specific duties of each one of the Regional Office's present emergency preparedness staff? What will be the duties of the new staff?

Federal Emergency Management Agency

Washington, D.C. 20472

APR

The Honorable Edward M. Kennedy
United States Senate
Washington, D.C. 20510

Dear Senator Kennedy:

This is in response to your letter of March 7, 1988, to Mr. Richard W. Krimm, Assistant Associate Director, Federal Emergency Management Agency (FEMA), in which you reiterated a question you had posed to him during the Senate Labor and Human Resources Committee hearings on the restart of the Pilgrim Nuclear Power Plant. Your letter also raised several additional questions concerning offsite planning at Pilgrim and related matters.

At the hearing you asked Mr. Krimm if he would support a Congressional initiative aimed at providing FEMA with separate regulatory authority to shut down or keep closed a nuclear power plant which did not have in place an approved emergency evacuation plan. The response to this question, which has already been provided for insertion into the hearing record, follows:

- On the whole the Nuclear Regulatory Commission (NRC) has used and reflected FEMA's offsite findings and determinations in all of its licensing decisions. This would indicate that the present arrangements are satisfactory;

- A change could bifurcate the current integrated licensing process resulting in two separate licensing processes, both onsite and offsite;

- It is estimated that FEMA would require an additional staff of 50 to 75 FTE and an increased annual budget of $ 7 to $ 8 million dollars. The additional resources would be required for judicial reviews, hearings, public meetings, and administrative requirements associated with regulatory activity.

In the enclosure to your letter you raised four additional questions concerning the status of offsite planning at Pilgrim, the size of the Pilgrim emergency planning zone (EPZ), evacuation assumptions, and FEMA Region I staffing. Your first question is related to FEMA's Self-Initiated Review and Interim Finding for the Pilgrim Nuclear Power Station and the progress the Commonwealth of Massachusetts has made in correcting the deficiencies identified by FEMA. The Massachusetts Civil Defense Agency (MCDA) submitted portions of draft plans for four local communities (Plymouth, Carver, Kingston, and Taunton) in February 1988 in an attempt to begin addressing the issues raised in the FEMA Self-Initiated Review and Interim Finding. An informal technical review by FEMA of the four draft plans was returned to MCDA on March 30, 1988. In addition, draft plans for two local communities (Duxbury and Bridgewater) were received on March 30, 1988, and are currently undergoing technical review in Region I. We have requested that our Region I Office provide more specific details on the planning progress that has been made by the Commonwealth of Massachusetts so that we can completely respond to the questions you raised. We will provide this additional information to you in early May.

-2-

In response to your second question, EPZ's around nuclear power plants are not being expanded as a result of the Chernobyl accident. This subject has been reviewed in NUREG-1251, "Implications of the Accident at Chernobyl for Safety Regulation of Commercial Nuclear Power Plants in the United States." I have enclosed a copy of this report for your information. Based on this report the NRC does not consider that a change to the existing size of the plume exposure pathway EPZ is necessary.

In response to your third question, FEMA has not established detailed requirements or specific assumptions regarding the effects of traffic and weather that must be considered in developing evacuation time estimates. Every site plan is required to have time estimates developed for the evacuation of the plume exposure pathway EPZ. Guidelines for evacuation time studies are provided in Appendix 4 of NUREG-0654/FEMA REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." At a minimum, a time estimate is recommended for "good" weather conditions and "adverse" weather conditions. It is important to emphasize that there are no minimum dose savings required by the NRC and therefore, no minimum evacuation time estimates can be established. However, the estimates provide information and decision points for responsible decisionmakers in adopting and approving plans for dealing with radiological emergencies. Knowledge of the amount of time required to evacuate a certain segment of the population enables the decisionmaker to choose the protective action recommendation likely to achieve the greatest dose savings for the public. Specifically, FEMA does not base its emergency preparedness assessments on worst-case scenarios, but includes consideration of such contingencies among the possible range of occurrences.

In response to your fourth question, our full-time FEMA Regional Office staff in Boston will be increased to the allocated total of eight full-time staff. Currently there are four full-time staff members on board. The FEMA Office of Personnel is in the process of recruiting four additional full-time staff. I have requested our Region I Office to provide the specific duties being performed by existing staff and those duties proposed for the four new staff members and will provide this to you as soon as it is received.

If we can be of any further assistance, please have a member of your staff contact the FEMA Office of Congressional Relations at 646-4500.

Sincerely,

Grant C. Peterson
Associate Director
State and Local Programs
and Support

(Editor's Note: Due to printing limitations, and in the interest of economy, the copy of NUREG-1251 referred to above was retained in the files of the committee.)

BOSTON EDISON
Executive Offices
800 Boylston Street
Boston, Massachusetts 02199

Ralph G. Bird
Senior Vice President — Nuclear

January 21, 1988

The Honorable Edward M. Kennedy, Chairman
Senate Committee on Labor & Human Resources
Senate Dirksen Office Building
Washington, D. C. 20510-6300

Re: **Pilgrim Nuclear Power Station**

Dear Senator Kennedy:

This letter and its attachments are intended to provide additional information to the Senate Committee on Labor & Human Resources and to clarify the record of the testimony presented at its hearing held on January 7, 1988, concerning the Pilgrim Nuclear Power Station.

Boston Edison Company appreciates the opportunity to provide this statement for the record.

R. G. Bird

Attachment

Boston Edison Company's Statement for the Record of the Senate Committee on Labor & Human Resources Hearing Held on January 7, 1988

Boston Edison Company is filing this statement to provide additional information to the Senate Committee on Labor & Human Resources and to clarify portions of the record of testimony presented at the January 7, 1988 hearing.

Boston Edison's first priority is the health and safety of the public and its employees. Boston Edison is committed to providing necessary sources of power for the citizens of Massachusetts at a reasonable cost. The restart and operation of the Pilgrim Nuclear Power Station is an important element in Boston Edison's ability to supply safe, reliable and sufficient power.

Boston Edison will not restart the Pilgrim Station until its management and Board of Directors are satisfied that the outstanding issues have been addressed and the plant and its personnel are ready to support safe and reliable operation. Stephen Sweeney, Chairman of the Board and Chief Executive Officer, and Ralph Bird, Senior Vice President-Nuclear, have repeatedly stated this policy.

Several specific issues were raised during the hearing that require correction or clarification. These include the possible health effects in communities near Pilgrim Station, elevated off-site dosimeter readings, loss of off-site power to Pilgrim on November 12, 1987, stoppage of construction work on November 9,

1987, off-site Emergency Planning for Pilgrim Station, and plans for eventual decommissioning of the plant.

Boston Edison strongly endorses Senator Kennedy's request that the National Institute of Health conduct a study of possible health effects in communities around nuclear power plants throughout the United States. Boston Edison has supported, and is currently supporting, localized studies which have been undertaken by the Commonwealth of Massachusetts.

In the interest of expediting a more complete understanding of leukemia incidence rates in five towns north of Pilgrim Station, Boston Edison commissioned Epidemiology Resources Incorporated (ERI) to review the report published by the Massachusetts Department of Public Health on March 16, 1987. The ERI analysis explains some of the difficulties in interpreting data from a study of small groups of people exposed to low doses of ionizing radiation. A copy of the results of this review is attached to this statement (Attachment A).

The term "downwind" was used to describe the location of the communities which were the subject of the Massachusetts studies (Transcript p. 43). However, the distribution of wind direction observations at the Pilgrim meteorological towers does not indicate that any direction is predominantly and consistently "downwind". However, the most commonly observed wind directions are generally out to sea, not toward the local communities.

The theory that the seabreeze effect is responsible for redirecting and concentrating airborne pollutants is not well supported by the available evidence. Investigation of this effect by knowledgeable meteorologists has determined that seabreezes rarely contain pollutants in a small radius and most never recirculate over the same location. In addition, seabreezes occur only seasonally and relatively infrequently.

The issue of elevated Thermoluminescent Dosimeter ("TLD") readings off-site (Transcript pp. 10-14) should be clarified. Radiation levels as measured by TLDs are measurably elevated at locations on the Pilgrim Station site during plant operation. Some individuals have confused on-site and off-site TLD locations and measurements which has led to allegations of higher radiation doses to the general public at off-site locations. Historically, within the standard fluctuation of background levels, there has been no detectable increase in direct radiation levels at any location that is normally occupied by members of the general public beyond the property owned by Boston Edison. The Massachusetts Department of Public Health has stated similar conclusions.

Even after the incident in June of 1982 where slightly contaminated resin was discovered on the Pilgrim site, a survey done just outside of the site fence using sensitive laboratory-type instruments was unable to detect elevated dose rates or evidence of off-site radioactive contamination. In fact, radiation levels on-site and within the Exclusion Area are much more strongly

affected by the Station's power level and direct radiation from the main turbine than from any release of radioactive material from the Station.

Several persons raised the issue of the loss off-site power on November 12, 1987 (Transcript pp.25-28). A line-to-line fault on off-site transmission lines during a severe winter storm resulted in loss of the 345KV line supplying power to Pilgrim Station. This has been fully investigated by a Nuclear Regulatory Commission ("NRC") Augmented Inspection Team ("AIT"). The AIT concluded that ". . . the operational staff responded well to the event and adequately coped with the equipment failure and malfunction." [Docket No. 50-293, Region I Inspection Report No. 50-293/87-53, December 14, 1987, page 1.] The AIT further found that reactor safety was never a factor as Pilgrim Station was in an extended outage and there was very low decay heat. In response to this incident, Boston Edison has committed to take a number of actions designed to improve the availability and reliability of on-site power prior to restart. Boston Edison has committed to complete the installation of: the new third Diesel Generator prior to restart; a backup instrument air compressor and additional instruments to analyze off-normal switchyard operation.

The issue of Boston Edison having ordered construction work stopped following events on November 9, 1987 was raised (Transcript p. 34). The specific errors were minor and are not safety or health concerns. Work was suspended to get prompt answers to management questions about errors, or possible errors, which had

occurred. Ralph Bird, Senior Vice President-Nuclear, did not permit work to proceed until the potential for further errors was understood and appropriate corrective actions had been initiated. Information on the specific events, the underlying causes, and the corrective actions has been provided to officials in the office of the Commonwealth of Massachusetts Secretary of Public Safety, as well as to the Nuclear Regulatory Commission.

With respect to the status of Emergency Planning issues, a topic of discussion throughout the hearing, Boston Edison has supported with funds, resources and personnel the efforts of the Commonwealth of Massachusetts and the towns in and around the Pilgrim Emergency Planning Zone ("EPZ") to revise and enhance their off-site Emergency Preparedness Program. Substantial progress has been achieved. This spirit of cooperation has resulted in such significant achievements as: (1) completion of draft revisions of the emergency plans for all five towns in the Pilgrim EPZ, the two reception center communities, and the Massachusetts Civil Defense Agency Area II; and (2) numerous agreements for renovation of local emergency operations centers; funding for full-time Civil Defense staff positions; and provision of training compensation from Boston Edison. The professional planning staff provided by Boston Edison is currently assisting the towns in developing specific implementation procedures and training lesson plans. The planning efforts underway encompass the actions necessary to assure satisfactory resolution of the concerns raised by the Federal Emergency Management Agency.

The record needs to be corrected with respect to one particular statement regarding the Pilgrim Emergency Planning effort. In the testimony of Ms. Ann Waitkus-Arnold (hearing transcript pp. 18- 20), she states that ". . . potassium iodine will be stockpiled [to provide thyroid protection] for those who will be left behind . . ." in an evacuation, and that such a policy is ". . . a very inhuman way to treat people, especially elders and disabled. Those are the only people targeted out for this particular type of treatment."

To the best of our knowledge, it has never been the intention of any of the parties involved in the emergency planning process that KI be administered to elderly or disabled persons in lieu of evacuation. On the contrary, the draft emergency plans to which Ms. Waitkus-Arnold referred in her testimony include specific provisions for the prompt evacuation of nursing home and hospital residents as well as the remainder of the special needs population. KI would be administered to elderly or disabled person only in those exceptional cases where medical authorities determine that, due to the condition of the particular individual involved, the evacuation itself could be life-threatening.

Finally, questions were raised about the planning for Pilgrim Station decommissioning (Transcript pp.55-56). In fact, Boston Edison has planned for eventual decommissioning of Pilgrim Station. A 1985 study done for Boston Edison by Nuclear Energy Services, Inc. describes three options for the decommissioning of Pilgrim Station which range in cost from $121,694,000 to $140,175,000.

Subject to the regulatory approval of the Department of Public Utilities (DPU) and the Federal Energy Regulatory Commission (FERC), the $121,694,000 option has been selected. Currently, Boston Edison is collecting from its customers about $5 million a year towards decommissioning which is being placed in a separate interest-bearing account with a current balance of approximately $16 million. The cost estimates and amount being collected are subject to continuing review by the DPU and the FERC.

LEUKEMIA INCIDENCE IN COMMUNITIES IN THE VICINITY OF THE PILGRIM I NUCLEAR POWER GENERATING STATION

September 11, 1987

Submitted to:

Boston Edison Co.
800 Boylston Street
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Prepared by:

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LEUKEMIA INCIDENCE IN COMMUNITIES IN THE VICINITY OF THE PILGRIM I NUCLEAR POWER GENERATING STATION

SUMMARY

The Boston Edison Company asked Epidemiology Resources Inc. to review analyses by the Massachusetts Department of Public Health (MDPH) of leukemia incidence rates in communities in the vicinity of Boston Edison's Pilgrim I nuclear power generating station. With data obtained from the Massachusetts Cancer Registry, we were able to replicate the main results of the analyses the MDPH has conducted thus far. The observed numbers of cases correspond exactly and the expected numbers almost exactly between our analyses and those of the MDPH.

We are critical of the way in which the MDPH has developed hypotheses about potential environmental exposure to ionizing radiation from Pilgrim I. The MDPH has concentrated on one highly speculative hypothesis about recirculating air above the coastline to the north of the facility. The MDPH has provided no supporting data for this unusual hypothesis, despite the availability of substantial amounts of meteorologic and radiation monitoring data. Neither has the MDPH contrasted the circulating-wind hypothesis with alternatives, such as the simpler hypothesis that exposure is directly proportional to the proximity of one's residence to the facility.

The MDPH analysis found elevated leukemia rates among adult males, but not among women or children, in five towns that lie along the coast to the north of Pilgrim I. That the increased incidence rates are limited to adult males is inconsistent with explanations that might be proposed in terms of general environmental exposures to ionizing radiation or other leukemogens. Adult males spend much less time, on average, in the immediate vicinity of their homes in this particular geographic area than do women or children. Consequently, adult males would receive the least amounts of such exposures, on average, of the three groups of people.

We found lesser elevations of leukemia incidence rates in 13 towns that lie within 17 miles of Pilgrim I than the MDPH found in the five coastal towns. Both our analyses and those of the MDPH yielded estimated leukemia incidence rate ratios that would be produced by high levels of radiation exposure, according to predictions from the Radioepidemiological Tables developed by the National Institutes of Health in 1985. These predicted doses, on the order of 1-100 rad per person, are much higher than would be expected in the communities near Pilgrim I or any other operating nuclear power plant. The Radioepidemiological Tables were developed for the purpose of estimating the probability that a cancer case was caused by radiation exposure. The Tables are often used for lower doses and dose rates than those for which effects have been reliably estimated. Doses of 1-100 rad, however, fall within the range of observed doses in the studies that were used to construct the Tables (e.g., studies of survivors of atomic bomb blasts). These were studies of comparatively high dose rates, but no

better data are currently available from which to estimate effects reliably at lower dose rates. Thus, attribution of elevated leukemia rates to ionizing radiation released to the general environment by Pilgrim I would imply either extraordinarily high exposure that has evaded environmental monitoring or substantial conflict with the Radioepidemiological Tables.

Of the accepted causes of leukemia, only occupational exposures to ionizing radiation or other leukemogens (e.g., benzene) or medical exposures to ionizing radiation would be high enough to produce the increases in incidence among adults that we and the MDPH have estimated for the towns near Pilgrim I. The case-control study under development by the MDPH should emphasize a thorough assessment of the occupational history of each study subject. This assessment should focus on ionizing radiation from all sources and on industrial solvents, especially benzene, and should include a plan for validation and quantification of reported exposures by contacting employers.

I. INTRODUCTION

The Boston Edison Company asked Epidemiology Resources Inc. (ERI) to review analyses by the Massachusetts Department of Public Health (MDPH) of leukemia incidence rates in communities in the vicinity of Boston Edison's Pilgrim I nuclear power generating station.[1] Boston Edison also asked ERI to conduct its own analyses.

In Section II of this report, we describe the data we obtained from the MDPH and other sources and the analytic methods we used. Section III presents the results of our successful efforts to replicate the main MDPH results. In Section IV, we offer a critique of the MDPH analyses, which are based on an undocumented meteorologic theory. In Section V, we use Radioepidemiological Tables developed by the National Institutes of Health in 1985[2] to predict the average ionizing radiation dose that would produce the association reported by the MDPH for leukemias other than chronic lymphocytic leukemia. Section VI presents the results of our own analyses, which are based on proximity of residence to Pilgrim I.

II. MATERIALS AND METHODS

To replicate the analyses already conducted by the MDPH, and to conduct our own analyses, we obtained from the Massachusetts Cancer Registry the following data:

1) Listings by histology, race, sex and age group of all cases of hematopoietic and reticuloendothelial cancers reported in the years 1982, 1983, 1984 in the Commonwealth of Massachusetts. These cancers are assigned code 169 in the International Classification of Diseases for Oncology (ICD-O).

2) Listings by hospital, date of diagnosis, sex, race, town, age, primary site, histology, and confirmation method of all cases with ICD-O code 169 in 24 Massachusetts towns in the vicinity of Pilgrim I (see Figure 1) for 1982, 1983, 1984.

To estimate the person-time in Massachusetts and the 24 towns, we obtained 1980 census data[3] and projections made for 1985 by the State Data Center.[4] We used linear interpolation within categories of age, sex, race and town for the years between 1980 and 1985 to estimate the number of persons living in the state and in each town each year and thus the total number of person-years for 1982-1984.

FIGURE 1

Twenty-four Towns Identified by the MDPH as Lying Within 20 Miles of Pilgrim I

SCALE OF MILES

0 5 10 15

Data entry and analysis posed various problems. The most significant problem concerned the classification of cancers reported to the Massachusetts Cancer Registry. For the years in question, the histologies of cancers reported to the Registry were coded with three different nosologic coding schemes: ICD-O, Systematized Nomenclature of Pathology (SNOP), and Healthstat. Although the SNOP and Healthstat codes are similar, there are substantial differences between these codes and ICD-O codes, which are the standard used by the MDPH and the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program. The MDPH had previously prepared a concordance among the coding schemes for leukemias; we obtained and used this concordance in our analyses after checking it for consistency.

We encountered other problems as we prepared the census data for entry. Census projections for 1985 were stratified by 5-year age group, gender and race (White, Black, Other). In all strata in which the number of people was fewer than 10, the State Data Center did not report the number. Whenever we could determine what the missing number was, we entered that number; otherwise, we arbitrarily entered the number 4. (Four was our estimate of the average number of unreported residents.)

Census figures for 1980 were not stratified in the same race and age categories as the 1985 data. The Bureau of the Census reported race as White, Black and Spanish origin. The category of Spanish origin included people who were also reported in White or Black classifications. People who were not White or Black were reported in the totals of the tables but

otherwise were not represented. We entered figures in categories of White, Black and Other, classifying as "Other" all people who were not White or Black and who were in the total. In towns where age groupings were not consistent with 1985 data, we distributed people proportionally according to their distribution in the state as a whole.

We wrote a computer program to read all data files and perform the calculations for the standardization of rates for individual towns and certain groupings of towns. We determined the observed number of cases and person-years by age and sex in each town or group of towns for the following leukemia subgroupings: acute lymphocytic, chronic lymphocytic, other lymphocytic, acute myelocytic, chronic myelocytic, other myelocytic, and all other leukemias.

To replicate the MDPH results, we combined these groupings into the following categories: leukemia, all subtypes (total leukemia, ICD-O codes 9800 to 9940); leukemia, all subtypes except chronic lymphocytic leukemias (non-chronic-lymphocytic leukemias, ICD-O codes 9800-9940 except 9823); and myelocytic leukemias (acute, chronic and other combined, ICD-O codes 9860 to 9866). It should be noted that these categories are not mutually exclusive; the second is a subset of the first and the third is a subset of the second.

In our analyses, we focused on the following leukemia categories: acute lymphocytic leukemia among persons age 0 - 19; chronic, acute and other myelocytic leukemias among adults; and other non-chronic-lymphocytic leukemias among adults. For adults, we also used a broad category employed

by the MDPH: all non-chronic-lymphocytic leukemias. Of the leukemias that occur primarily among adults, chronic myelocytic leukemia has received particular attention in the literature on ionizing radiation and leukemia.[2,5] Acute lymphocytic leukemia, which has also been linked to radiation exposure, is the predominant type of leukemia among children. We did not include chronic lymphocytic leukemia because of its consistent lack of association with ionizing radiation in the studies of higher exposures.

Like the MDPH, we stratified the data for adult leukemias by gender because of expected differences in exposure between men and women. Men are expected to receive a greater share of the effect of many occupational exposures and women are expected to receive a greater share of the effect of domiciliary environmental exposures. Unlike the MDPH, we also stratified by age. There were two reasons. First, the differences in exposure between males and females apply only to adults; children do not receive occupational exposures and boys and girls would receive an equal degree of environmental exposure. Second, as noted above, the specific leukemia types are highly related to age.

In contrast with the MDPH analyses, we did not compare a specific town or group of towns with Massachusetts as a whole, since the figures for Massachusetts would include the data for that town or group of towns. Instead, for comparison, we computed rates in the <u>remainder</u> of Massachusetts by taking the total number of cases and the total number of person-years in the Commonwealth within each category of sex, race (Black,

White, Other) and age (five-year categories) and subtracting from this total the corresponding number for the specific town or group of towns of interest.

III. REPLICATION OF THE MDPH RESULTS

In Tables 4a - 4d of the MDPH's report of March 16, 1987[1], data are presented on the observed and expected incidence of cancers of the hematopoietic and reticuloendothelial system, with a specific focus on incidence of leukemias. We attempted to replicate the calculations of the observed and expected numbers of cases of leukemia in the five coastal towns of Plymouth, Kingston, Duxbury, Marshfield and Scituate during the years 1982-1984 (see Table 1). The observed numbers of cases of all leukemias, all non-chronic-lymphocytic leukemias, and all myelocytic leukemias in the data available to us were identical to the figures reported in the March 16th report.

Our calculations of the expected numbers of cases in some categories differed slightly from those of the MDPH. One reason for the difference may be that our expected numbers are based on the rates observed in the remainder of Massachusetts, whereas the expected numbers determined by the MDPH are based on rates for the entire State, including the town or towns involved in the comparison. A second reason may be that we had to make minor approximations for those few numbers that were not reported in the town census figures.

We calculated incidence rate ratios standardized to the age-race distribution of the population whose incidence rate was the numerator of each ratio. Rate ratios that are standardized in this way are known as SMRs.[6] Each SMR may be considered the ratio of observed to expected

numbers of incident cases. SMRs determined from data reported by the MDPH and from our own calculations are shown in Table 1. The differences between our results and those of the MDPH are trivial.

TABLE 1

Comparison of MDPH and ERI Calculations of Observed and Expected Cases of Leukemia in the Five Coastal Towns Selected by the MDPH, by Sex, 1982–1984

	OBSERVED		EXPECTED		SMR	
	MDPH	ERI	MDPH	ERI	MDPH	ERI
Leukemia-all subtypes:						
Males	22	22	12.1	12.7	1.82	1.73
Females	12	12	9.3	9.8	1.29	1.22
TOTAL	34	34	21.4	22.5	1.59	1.51
Leukemia-all subtypes except CLL:						
Males	19	19	9.4	9.2	2.02	2.07
Females	8	8	7.6	7.8	1.05	1.03
TOTAL	27	27	17.0	17.0	1.59	1.59
Leukemia-Myelocytic only:						
Males	13	13	5.2	5.0	2.50	2.60
Females	6	6	4.8	5.0	1.25	1.20
TOTAL	19	19	10.0	10.0	1.90	1.90

IV. CRITIQUE OF THE MDPH ANALYSES

In the report issued on March 16th, the MDPH presented data from 24 towns that lie approximately within a 20-mile radius of Pilgrim I. The MDPH report focused on five coastal towns near the plant -- Plymouth, Kingston, Marshfield, Duxbury and Scituate -- chosen because of "their proximity to the Pilgrim plant, area topography, and coastal meteorological conditions" (p.1). Pilgrim I is located in Plymouth. The other four towns lie northward along the Atlantic coast.

The hypothesis that resulted in the selection of the five towns relies on the supposition of a "'circulating' pattern of air" that would be created by the temperature differential between land and sea masses and that would trap radiation from Pilgrim I and continually expose coastal residents to it. To date, the only meteorologic reference cited by the MDPH is a drawing entitled "Land and sea breezes," from Dr. Frank Field's Weather Book.[7] No meteorologic data or measurements of emissions or environmental radiation levels in the geographic aea around Pilgrim I have been used, despite the acknowledgement by the MDPH that large amounts of such data are available. In the absence of any data supporting this particular selection of towns to study, we have chosen to expand the analysis to include other towns in the vicinity of Pilgrim I (see Section V).

If there were an environmental exposure producing a geographically localized increase in a disease rate, we would expect to find the same or a greater increase in the incidence rate among women than among men, because

of differences in exposure that might be experienced in each group. Data based on 1980 census figures and prepared by the Data Resource Center of Boston Central Transportation Planning reveal that for the five-town area studied by the MDPH, 81% of males over age 16 work outside the home, in contrast to 51% of females. Of those who were in the workforce in 1980, 64% of men and 45% of women who lived in the five-town area worked outside of that area.[3,8] Thus, 77% of women but only 48% of men who lived in the five-town area in 1980 remained in that area during the work week. Therefore, adult women (and, of course, children of both sexes) would receive a greater share than adult men of any hypothetical exposure that was geographically localized in the five towns, and would sustain a greater effect if that exposure increased the incidence of one or more types of leukemia.

When viewed in light of previous studies of the effects of exposure to ionizing radiation, results of the five-town analyses suggest that radiation exposure is an insufficient explanation for the elevated leukemia rates in this area. Studies conducted in the United Kingdom have indicated possible excesses of leukemia in children, but not of adults, living in the vicinity of nuclear power generating facilities.[9,10,11] Biological Effects of Ionizing Radiation (BEIR) and Radioepidemiological Table reports also indicate greater relative risks for leukemia due to radiation exposure among children than among adults.[2,5] By contrast, neither acute lymphocytic leukemia in particular (Table 2) nor non-chronic-lymphocytic leukemia in general (Table 3) was elevated among children in the five towns selected by the MDPH. Adult males, but not females, in the five towns had elevated

rates of myelocytic leukemias and of all other non-chronic-lymphocytic leukemias considered as a group (Table 4). The elevated rates of chronic and acute myelocytic leukemias among men were the most pronounced and statistically stable, as indicated by the comparative widths of the confidence intervals for these leukemia types.

TABLE 2

Observed and Expected Incidence of Acute Lymphocytic Leukemia Among Residents of the Five Towns Selected by the MDPH, by Age (0-19) and by Sex, 1982-1984

Sex	Cases: Observed	Cases: Expected	SMR	90% Confidence Interval
Male	2	1.42	1.40	0.34 - 4.01
Female	0	1.04	0.00	0.00 - 2.21
Both	2	2.46	0.81	0.20 - 2.31

TABLE 3

Observed and Expected Incidence of All Leukemias Except Chronic Lymphocytic Leukemia among Residents of the Five Towns Selected by the MDPH, by Age and Sex, 1982-1984

Age	Sex	Cases Observed	Cases Expected	SMR	90% Confidence Interval
0-19	Males	2	1.92	1.04	0.25 - 2.96
	Females	1	1.48	0.67	0.07 - 2.78
	Both	3	3.41	0.88	0.29 - 2.10
≥20	Males	17	7.29	2.33	1.49 - 3.50
	Females	7	6.34	1.10	0.56 - 1.98
	Both	24	13.63	1.76	1.21 - 2.48
All	Males	19	9.21	2.06	1.35 - 3.03
	Females	8	7.82	1.02	0.55 - 1.77
	Both	27	17.03	1.59	1.12 - 2.19

TABLE 4

Observed and Expected Incidence of Leukemia Among Adult Residents (Age ≥ 20 Years) of the Five Towns Selected by MDPH, by Leukemia Type and Sex, 1982–1984

Leukemia Type	Sex	Cases Observed	Cases Expected	SMR	90% Confidence Interval
Chronic myelocytic	Male	3	1.13	2.66	0.89 - 6.34
	Female	0	0.97	0.00	0.00 - 2.37
	Both	3	2.10	1.43	0.48 - 3.41
Acute myelocytic	Male	9	2.86	3.15	1.75 - 5.30
	Female	4	3.29	1.22	0.48 - 2.60
	Both	13	6.14	2.12	1.31 - 3.28
Other myelocytic	Male	1	0.62	1.62	0.16 - 6.63
	Female	1	0.40	2.48	0.25 -10.28
	Both	2	1.02	1.96	0.48 - 5.58
Total myelocytic	Male	13	4.60	2.82	1.74 - 4.37
	Female	5	4.66	1.07	0.48 - 2.13
	Both	18	9.27	1.94	1.25 - 2.88
Other non-chronic-lymphocytic	Male	4	2.68	1.49	0.59 - 3.20
	Female	2	1.68	1.19	0.29 - 3.39
	Both	6	4.36	1.38	0.66 - 2.59
Total non-chronic-lymphocytic	Male	17	7.29	2.33	1.49 - 3.50
	Female	7	6.34	1.10	0.56 - 1.98
	Both	24	13.63	1.76	1.21 - 2.48

Our comparisons of the SMRs in Tables 2-4 would not be valid if the distributions of age, race or sex differed substantially between compared groups and if any or all of these factors modified the effect of some cause or causes of leukemia associated with living in the five-town area. The reason for this possible lack of comparability is that each SMR is, in principle, standardized to a different distribution of these variables. We checked these distributions and found them not to differ appreciably. In particular, the distributions of race and sex are virtually identical in the age groups we have compared, as are the distributions of age and race in the comparisons between men and women. Consequently, these results would not change appreciably if the rate ratios were standardized to identical distributions of these variables.

V. RADIATION DOSES PREDICTED FROM RADIOEPIDEMIOLOGICAL TABLES

The NIH Radioepidemiological Tables can be used to compute the ionizing radiation dose that would produce a given increase in incidence, such as the SMR of 1.59 for all non-chronic-lymphocytic leukemias in Table 3. The Tables predict the probability of causation (PC) of cases of leukemia in people of given ages who were exposed to certain doses of low-LET radiation (1, 10, or 100 rad) at given ages.[2] (These predictions are based on studies in which doses were received at higher dose rates than in the population near Pilgrim I.) To take a single example, Table PC-1-C-30 gives a probability of causation (PC) of 28% for a man diagnosed with a non-chronic-lymphocytic leukemia at age 35 after having received a dose of 10 rad at age 30. We shall use this Table and the other Tables for non-chronic-lymphocytic leukemias to compare the predictions with the MDPH results for the five-town area.

The PC, also known as the attributable proportion for the exposed population,[12] can be expressed as a direct function of the incidence rate ratio (RR):

$$PC = \frac{RR - 1}{RR} \qquad (1)$$

We can rearrange this equation to express the RR as a function of the PC:

$$RR = \frac{1}{1 - PC} \qquad (2)$$

Thus, PC = 28% in the example above corresponds to RR = 1.39. The tables therefore predict that a study of a group of men age 35 who received a dose of 10 rad at age 30 would produce an RR of 1.39 for non-chronic-lymphocytic leukemia.

The PC may be viewed as the proportion of a group of exposed cases that is attributable to the exposure. An analogous measure is the attributable proportion for the total population (AP_T), which is the proportion of a group of exposed and unexposed cases that is attributable to the exposure.[12] One expression for this measure is a combination of the RR and the exposed proportion of the population (P_e):

$$AP_T = \frac{P_e\,(RR - 1)}{P_e\,(RR - 1) + 1} \qquad (3)$$

We can rearrange this equation to express the RR as a function of the AP_T and the P_e:

$$RR = \frac{AP_T - (AP_T/P_e) - 1}{AP_T - 1} \qquad (4)$$

We used equations 2 and 4 to compute the SMR that the Radioepidemiological Tables would predict for the population of the five-town area if all or part of that population were to receive a dose of 1, 10 or 100 rad. (The SMR is a standardized RR, standardization being a way of controlling confounding by such factors as age.) To do so, we assumed an average induction time of eight years, corresponding to the interval between 1975 and 1983. (We chose 1975 as the time of exposure in this illustrative computation because several MDPH authors expressed interest in an exposure period ending in 1975.[13,14] We chose 1983 as the end of the induction period because 1983 is the midpoint of the three-year interval for which leukemia incidence data are available.) To simplify the computations, we applied the Radioepidemiological Table for exposure at age zero to the person-time in the five-town area for ages 0-9, the Table for exposure at age 10 for the age-group 10-19, etc.

To see how the computations proceeded, consider males in the age group 0-9 and a dose of 1 rad. Radioepidemiological Table PC-1-C-0 gives PC = 13% for cases occurring eight years later (corresponding to the eight-year induction time assumption). With equation 2, we obtained RR = 1.15.

From the age- and sex-specific rate for the rest of the Commonwealth, we obtained an expected number of 1.16 cases in this stratum for the five-town area. We multiplied this number by the RR to yield a predicted number of 1.33 observed cases. After repeating these computations for all categories of age and sex, we added the expected numbers together and we added the predicted-observed numbers together. The predicted-observed total divided by the expected total equals the hypothetical SMR that the Radioepidemiological Tables predict would be produced in the five towns, eight years after the population of the area received an average dose of 1 rad. We then repeated the entire set of calculations for doses of 10 rad and 100 rad.

The results are as follows:

DOSE	PREDICTED SMR
1 rad	1.11
10 rad	1.50
100 rad	8.80

These predictions should be compared with the observed SMR of 1.59 obtained by comparing the five-town area to the rest of the Commonwealth (see our Tables 1 and 4). This comparison is premised on the hypothesis that the average radiation dose was sustained by all members of the five-town area; it indicates that the average dose would have been approximately 10 rad. The MDPH has assumed, however, that exposure occurred in only a subset of this population in its proposal to conduct a case-control study

restricted to the five towns.[15] (Without this assumption, the proposed study would contain no unexposed people.) The assumption of restricted exposure was explicitly made by Dr. Sidney Cobb and several MDPH co-authors,[14,16] who claimed to have found a four-mile by twenty-mile area within which the entire excess of non-chronic lymphocytic leukemias was confined.

We do not know what proportion of the population of the five-town area lives in the four-by-twenty mile strip. Neither can we predict the proportion that would be classified as exposed under alternative exposure hypotheses. We can, however, use equation 4 to compute the RR that would correspond to any given exposed proportion, P_e, of the population in those 5 towns. For example, we can see from equation 4 that if $P_e = 1.00$ (i.e., the entire population is exposed), then:

$$RR = \frac{-1}{AP_T - 1} = \frac{1}{1 - AP_T}$$

Comparing this expression with equation 2, we can see that when $P_e = 1.00$, $AP_T = PC$.

Another expression for the AP_T is as follows:[12]

$$AP_T = \frac{I_T - I_0}{I_T}$$

where I_T is the rate in the total population of exposed and unexposed people and I_0 is the rate among unexposed people.

We can divide the top and bottom portions of the right-hand side of this equation by I_0 to obtain the following expression:

$$AP_T = \frac{(I_T/I_0) - 1}{I_T/I_0} = \frac{SMR - 1}{SMR}$$

The quantity, I_T/I_0, is equivalent to the SMR comparing the five-town area to the rest of the Commonwealth, under the assumption that only part of the population of the five-town area is exposed. Thus, the SMR of 1.59 for the five-town area as a whole corresponds to $AP_T = (1.59 - 1)/1.59 = 0.37$, or 37% of the cases in the area hypothetically attributable to the exposure. If only half of the population was exposed, $P_e = 0.50$ and, according to equation 4, RR = 2.18. This value is the predicted RR that the case-control study proposed by the MDPH would estimate for the exposed subset of the population of the five towns, if the apparent excess were in fact attributable to the exposure. The value of this RR would not change if the study were expanded to include other towns, because under this exposure hypothesis the enlargement of the study would merely add to the size of the unexposed portion of the population.

We have calculated the predicted RR that would be estimated for the exposed subpopulation of the five towns, assuming a wide range of values for the proportion of the population of the towns that is classified as exposed.

These are shown in Table 5. If the exposed proportion (e.g., within the four-by-twenty mile strip described by Cobb et al.) is as low as five per cent of the overall population in the five towns, the corresponding RR would be as great asP12.78.

We can now compare these RRs to the predicted SMRs we computed for the five-town area from the Radioepidemiological Tables (see page 20 above). The Tables predict that, if the entire five-town area were exposed to ionizing radiation responsible for the estimated SMR of 1.59 for that area, the radiation dose would have been on the order of 10 rad per person on average. The smaller the subset of the population for which the average dose is computed, the higher the RR and the higher the corresponding average dose to that subset that would be predicted by the Radioepidemiological Tables. As noted above, the RR of 1.59 under the assumption of P_e = 100% corresponds to about 10 rad per person. The Tables predict an RR of 8.8 for an average dose of 100 rad. This RR corresponds to a P_e of 8% (see Table 5). Although the four-by-twenty mile strip identified by Cobb et al. may contain less than 8% of the area's population, it seems safe to conclude that the elevated leukemia incidence rate in the five towns corresponds to an average dose of 10-100 rad per person according to the Radioepidemiological Tables.

TABLE 5

Rate Ratios (RR) Corresponding to Different Exposed Proportions (Pe) in a Total Population (Exposed and Unexposed) with an Attributable Proportion (AP_T) of 37%

P_e (%)	RR*
100	1.59 (10 rad)
95	1.62
90	1.65
80	1.74
50	2.18
20	3.94
10	6.89
8	8.80 (100 rad)
5	12.78

* The RRs that would be produced by ionizing radiation dose levels of approximately 10 and 100 rad, according to the Radioepidemiological Tables, are indicated.

We have no knowledge of any attempt to estimate quantitative exposure levels corresponding to the circulating-wind hypothesis proposed by Dr. Cobb and the MDPH. It is our understanding, however, that this hypothesis would predict average doses at least two orders of magnitude lower than 10-100 rad per person.

There are several uncertainties and assumptions in the computations we have made with the Radioepidemiological Tables. Nevertheless, the predicted doses are so high that one of two conclusions must be true. One is that the Tables underestimate the effect of low-level ionizing radiation at low dose

rates on non-chronic-lymphocytic leukemias by at least two orders of magnitude. Because the Radioepidemiological Tables are based on studies in which observed radiation doses were in the range of 10-100 rad, this first conclusion would imply that radiation doses differing by several orders of magnitude (but received at different dose rates) produce the same increase in leukemia incidence. The second conclusion is that ionizing radiation from Pilgrim I cannot be responsible for even a small proportion of the 59 per cent elevation in incidence reported for the five towns as a whole.

VI. LEUKEMIA RATES IN RELATION TO PROXIMITY TO PILGRIM I

Given the current lack of an exposure assessment scheme based on meteorologic and environmental radiation monitoring data for the environs of Pilgrim I, we offer as an alternative to the circulating-wind hypothesis the standard approach of grouping towns solely on the basis of proximity to the plant. The towns of Duxbury, Kingston, Plympton, Carver and Plymouth form an approximate semicircle around the plant with a radius of about 13 miles. We place these towns into Zone I (see Figure 2).

The next set of eight towns -- Marshfield, Pembroke, Hanson, Halifax, Middleboro, Wareham, Bourne and Sandwich — lie within a ring formed by adding a second semicircle approximately 17 miles from Pilgrim I. We call these towns Zone II.

Zone III consists of the remaining 11 towns on the list compiled by the MDPH. As shown in Figure 2, Zone III is somewhat patchy. It might have been advisable to include Lakeville, Mattapoisett, and Falmouth in this zone. Because these towns were not on the original MDPH list, we did not obtain data for them from the Cancer Registry. Zone IV is the remainder of the Commonwealth of Massachusetts.

FIGURE 2

Towns in Four Zones
of Proximity to Pilgrim I*

*NOTE: Lakeville, Mattapoisett and Falmouth are in Zone IV (see text)

Table 6 shows our comparisons of leukemia rates for all four zones. We used Zone IV, the farthest zone from Pilgrim I, as the reference category. An incidence rate ratio (RR) of 1.00 is arbitrarily assigned to this zone. The RRs for the other zones indicate the relative degree to which the rate in each zone exceeds or falls short of the rate in Zone IV. The RRs in each row of Table 6 are "directly" standardized (SRR) to the age distribution in Zone IV. An effect that would steadily decline with distance from the plant would be indicated by a steadily increasing set of SRRs from Zone IV to Zone I.

As shown in Table 6, the rates in Zones III and IV were very similar for every type of leukemia examined except for childhood acute lymphocytic leukemia, for which the rate in Zone III exceeded the rate in Zone IV by 30% (SRR = 1.30). For all leukemia types in Table 6, the rates in Zones I and II more closely resembled each other than did the rates in the other two zones. The rate of childhood acute lymphocytic leukemia was depressed and the rates of the other leukemia types among adults were somewhat elevated in Zones I and II. The proportional elevation was greater, nearly a 50% excess, for all myelocytic leukemias as a group than for other leukemia subtypes.

TABLE 6

Directly Standardized Incidence Rate Ratios in Zones of Proximity to Pilgrim I*, by Age and Leukemia Type, 1982-84

Leukemia Type	Age	Proximity Zone* IV	III	II	I
Acute lymphocytic	0-19	(1.00)	1.30	0.75	0.60
Chronic myelocytic	≥20	(1.00)	0.95	1.92	1.44
Acute myelocytic	≥20	(1.00)	1.18	1.38	1.42
Other myelocytic	≥20	(1.00)	0.61	0.97	1.47
Total myelocytic	≥20	(1.00)	1.13	1.46	1.46
Other non-chronic-lymphocytic	≥20	(1.00)	0.88	1.26	0.95
Total non-chronic lymphocytic	≥20	(1.00)	1.01	1.39	1.29

*See Figure 2

To simplify these computations, we made a comparison between the 13 towns in Zones I and II and the 11 towns in Zone III, leaving the remainder of Massachusetts out of the analysis. This dichotomization of the 24 towns selected by the MDPH divides the person-time in this geographic area approximately in half and improves comparability by removing the influence of any differences that might exist between this part of the Commonwealth and such areas as Boston and Western Massachusetts.

Table 7 shows the results of this analysis. The rate of childhood acute lymphocytic leukemia in Zones I and II is only half the rate in Zone III. Among adults, the total elevation of all non-chronic-lymphocytic leukemias is not as great as in the five-town area defined under the exposure hypothesis of Dr. Cobb and the MDPH (Tables 3 and 4). There are differences within this category as well. The rate ratio in the MDPH five-town area was greater for myelocytic leukemia, whereas types of leukemia other than myelocytic leukemia were in greater excess in Zones I and II. The disparity by sex appears to be present for myelocytic leukemia (an elevated rate among men but not women), but for the other non-chronic-lymphocytic leukemias there is an indication in our analysis of a greater elevation among women than among men. These estimates are very imprecise, as indicated by the confidence intervals in Table 7. When all adult, non-chronic-lymphocytic leukemias are considered as a group, there is little if any disparity by sex.

As in our analysis of the data for the five towns selected by the MDPH, we confirmed that the distributions of the stratification factors were

nearly identical between the subpopulations for which we compared SMRs. In addition, the comparison of SMRs to "crude" (i.e. unstandardized) RRs in Table 7 indicates little confounding by age or sex. Thus, we computed confidence intervals for the crude RRs.

TABLE 7

Crude Rate Ratios and Selected SMRs
Comparing Zones I and II with Zone III, by Age and Sex

Leukemia Type	Age	Sex	Crude Rate Ratio*	90% Confidence Interval
Acute lymphocytic	0 - 19	Both	0.53 (0.48)	0.15 - 1.83
Total myelocytic	≥ 20	Male	1.22	0.63 - 2.37
		Female	1.05	0.43 - 2.54
		Both	1.16 (1.18)	0.68 - 1.97
Other non-chronic-lymphocytic	≥ 20	Male	1.15	0.40 - 3.31
		Female	3.14	0.55 - 17.91
		Both	1.55 (1.69)	0.63 - 3.78
Total non-chronic-lymphocytic	≥ 20	Male	1.20	0.68 - 2.10
		Female	1.34	0.62 - 2.93
		Both	1.25 (1.29)	0.79 - 1.98

* Selected SMRs in parentheses

These results differ in some ways from those obtained under the MDPH exposure hypothesis. Under the circulating-wind hypothesis proposed by the MDPH, there is a clear difference by sex among adults, with only men having an elevated rate of myelocytic leukemia. This observation, as noted above, is inconsistent with an effect of domiciliary environmental exposure. Under the proximity-based exposure hypothesis, on the other hand, the association among adults is not restricted to men. This observation favors the proximity-based exposure scale under the causal hypothesis.

The estimated incidence rate ratios are lower using the proximity-based exposure scale than under the circulating-wind hypothesis. By corresponding to lower predicted radiation dose, these observations put the proximity-based scale slightly more in line with existing theory and data (as represented by the NIH Radioepidemiological Tables) than the circulating-wind hypothesis. Nevertheless, the estimated rate ratios still correspond to predicted exposures that are much higher than would be expected under any quantitative exposure hypothesis based on radiation monitoring data and meteorology in the geographic area near Pilgrim I. The estimated rate ratio of 1.25 for all non-chronic-lymphocytic leukemias in Table 7, for example, corresponds to a dose of 1-10 rad according to the predictions from the Radioepidemiological Tables (see page 20) and the computation of an average dose for all residents of Zones I and II. An even higher dose would be predicted if the average were computed for a subset of this population.

Under either exposure hypothesis, however, there is either no increase or even a deficit of acute lymphocytic leukemia among children in towns that

are hypothesized to have received greater degrees of environmental radiation exposure. This observation is inconsistent with a causal interpretation in terms of radiation released from Pilgrim I to the general environment.

The comparatively high rate ratios and the restriction of the elevated rates to adults in these analyses tend to run counter to the hypothesis of environmental radiation exposure. On the other hand, these observations might be predicted by hypotheses concerning occupational exposures to leukemogens. Such exposures would include ionizing radiation and industrial solvents, especially benzene.

From the data available thus far, it would be prudent to concentrate available resources on developing and implementing an in-depth occupational exposure assessment plan for the case-control study the MDPH is planning. A complete occupational history should be obtained for all cases and controls. Employers should be contacted for details of the work history of each individual. Workplace exposures to ionizing radiation, benzene, and other industrial solvents should be emphasized. Such exposures are more promising explanations for the observed pattern of leukemia rates in this part of Massachusetts than any hypothesis of widespread environmental exposure to ionizing radiation.

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U. S. SENATE
COMMITTEE ON LABOR AND HUMAN RELATIONS
HEARING ON RESTART OF PILGRIM NUCLEAR PLANT, 1/7/88

Statement of Dr. Sidney Cobb

I am Sidney Cobb MD MPH, Professor Emeritus of Community Health in the Brown University Medical Program. My degrees are from Harvard and my clinical training was at the Johns Hopkins Hospital. I taught epidemiology from 1953 until my retirement in 1979. I have published five books and over 100 scientific papers in refereed journals. Almost all of my written contributions have been reports of epidemiologic investigations. For the last three years I have been studying the environmental aspects of nuclear power in New England with particular reference to the effects on human health.

Much to the annoyance of some of my colleagues I take no position on the propriety of using nuclear fission to generate electricity for domestic use. I maintain that any society that can put a man on the moon and bring him back again can operate a nuclear power plant safely.

The price of complete safety may be too high, but an acceptable level of risk can and must be achieved. I take it that one purpose of these hearings is to ascertain the level of risk from a nuclear plant that the area residents would find acceptable. Route 3 from Plymouth to Boston has a lot of accidents, yet many area residents take the risk regularly and would describe the trip as safe. Curiously the same numerical risk is not considered "safe" across a variety of other risks and benefits. The balancing of risks and benefits is always a delicate task. In particular it is important to determine if the people taking the risks are the people that are getting the benefits and if the persons taking the risks have any choice in the matter. In the case of the automobile the risk takers and the beneficiaries are mostly the same, and the risks are taken voluntarily. However, for the power generation situation, those who recieve the benefits are usually at little if any risk; and those who are at risk have little if any choice in the matter.

I enclose several documents:-

1. "Leukemia in Five Massachusetts Towns - Abstract for the American Epidemiological Society, Mar 18, 1987.

2. "Commonwealth of Massachusetts, Joint Committee on Energy

– Testimony of Sidney Cobb MD, March 24, 1987.

3. Clapp RW, Cobb S, Chan CK & Walker B Jr. Leukemia Near Massachusetts Nuclear Power Plant. Letter to the Editor, **Lancet**, Dec. 5, 1987, p1324.

4. MEMORANDUM, Dec 15, 1987; To Bruce Cohen; From Dick Clapp; Subject Epidemiologic Resources Inc. Critique. (This is an internal memorandum of the State Health Dept. indicating possible lines of reply to a crtique of the work that Dick Clapp and I have done that was prepared by Epidemiology Resourcs Inc. under contract with Boston Edison Co. I assume the Committee has received a copy. If not I will be glad to furnish one.)

5. Correspondence with Maine Yankee Atomic Power Inc. This is included because the great similarity between what happened in Massachusetts and what happened on a similar part of the Maine coast strengthens the suspicion that the effect might be radiogenic.

In conclusion, it appears to me that there are two coastal areas in which an excess of leukemia has shown up roughly five years after a substantial release of radioactive materials from a nuclear power plant at the southerly tip of the area. Investigation by the several State Health Departments are continuing. At the moment it seems possible that these small epidemics of leukemia are causally related to the antecedent releases from the relevant plants. Further dispassionate and unbiased research is required. Some of this research should be directed at the suspicious increases in infant mortality and congenital defect that might also be related. If it seems clear that these are related the theory of radiogenicity will be strengthened. Also it will be important to study the summer residents on the beaches of these coastal towns and to look at the possible pathways via the air, the water and the air-water interface. I believe that Federal funds should be made available for this kind of research.

Sidney Cobb

Sidney Cobb

4 Water St.
S. Easton MA 02375
January 6, 1988

LEUKEMIA IN FIVE MASSACHUSETTS COASTAL TOWNS

Abstract for American Epidemiologic Society
March 18, 1987

Sidney Cobb, Richard W. Clapp, L. K. Chan & Bailus Walker Jr.
with the assistance of J. E. Perkins

Coastal distribution of leukemia adjacent to nuclear installations has been observed in England, in Scotland and in the State of Maine. It seemed possible that a similar situation might exist near the Pilgrim I nuclear plant on Massachusetts Bay. The hypothesis was that, as in Maine, the effect would be in the towns down wind, ie north of the plant and would begin some five years after activation of the plant. This plant went on line December 1972.

Cancer registry data, available only for the years 1982-84, show SIR's with 95% confidence intervals for the five towns north of the plant as follows: hematopoetic & reticuloendothelial cancer 156 (118,206), leukemia 159 (113,224) and myelogenous leukemia 191 (120,304). No such excess occurs inland or south along the coast.

Mortality data, in five year groupings, show SMR's that began to be excessive about 1979. Analysis by census tract reveals essentially all the excess incidence in the coastal tracts, defining the affected area as less than five miles wide and about 20 miles long. Occupational data reveal no clustering. Water and milk supplies are many and do not fit this narrow coastal pattern.

Reported airborne releases from the plant are too small to produce this effect, unless the effluent were held to a coastal distribution by some meteorologic pattern. Such a pattern is well known to meteorologists.

If this excess leukemia was caused by radioactive material released from the plant, the releases might have been followed promptly by some adverse reproductive outcomes. The largest reported releases from the plant were between 10/74 and 9/75. In the period 1975 & the infant mortality rates and the rates for congenital defects reported on birth certificates were elevated in certain essentially identical areas that are related to the plant and to the area of leukemia. These reproductive effects were more widespread than the leukemia, but they support the hypothesis of radiogenicity.

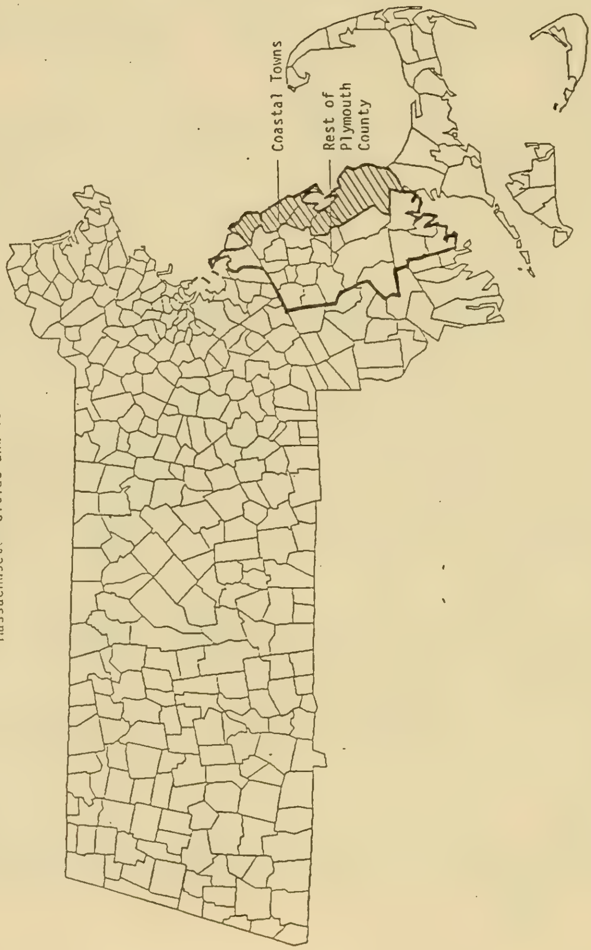


FIGURE 1.
Massachusetts- Cities and Towns

FIGURE 2.

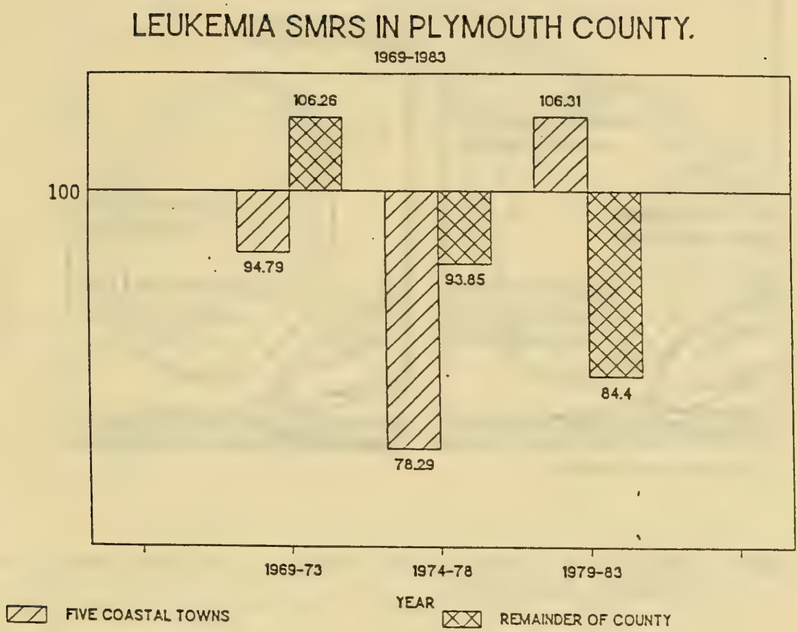
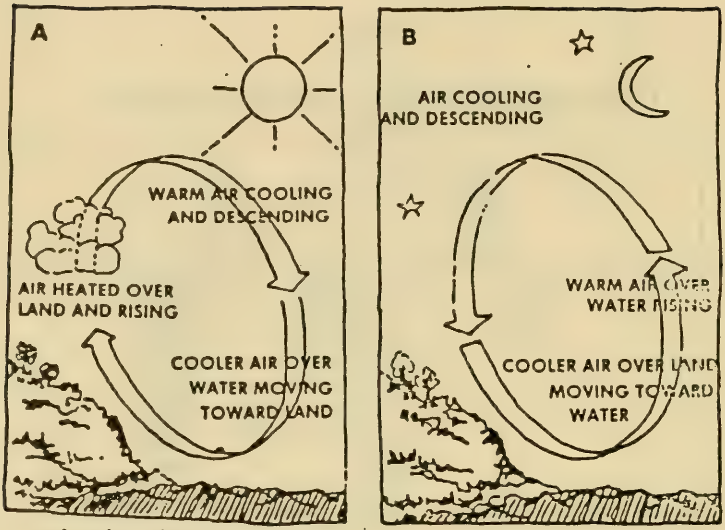

LEUKEMIA SMRS IN PLYMOUTH COUNTY.
1969-1983
100
106.26
94.79
106.31
93.85
78.29
84.4
1969-73
1974-78
1979-83
YEAR
FIVE COASTAL TOWNS
REMAINDER OF COUNTY

FIGURE 3.



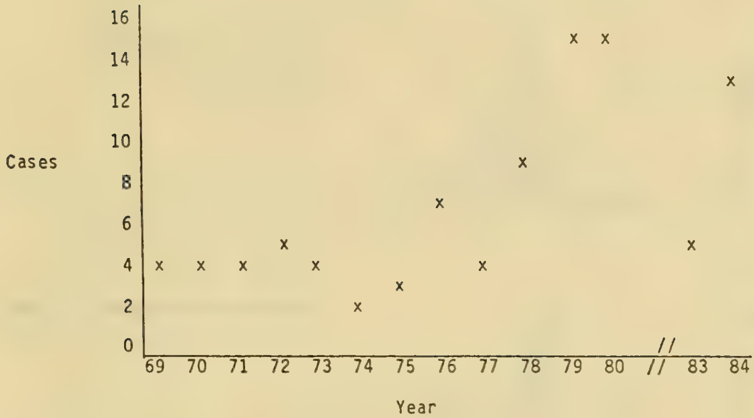
Land and sea breezes.

SOURCE: Field F: Dr. Frank Field's Weather Book. New York: G.P. Putnam's Sons, 1981.

Figure 4.

Leukemia Incidence in Lincoln, Knox and

Waldo Counties, Maine, 1969-80 and 1983-84



NOTE: The data from 1969-1980 are from Stutzman, et al (13). The data for 1983-1984 are from the State of Maine (14). There were no published data in 1981-1982.

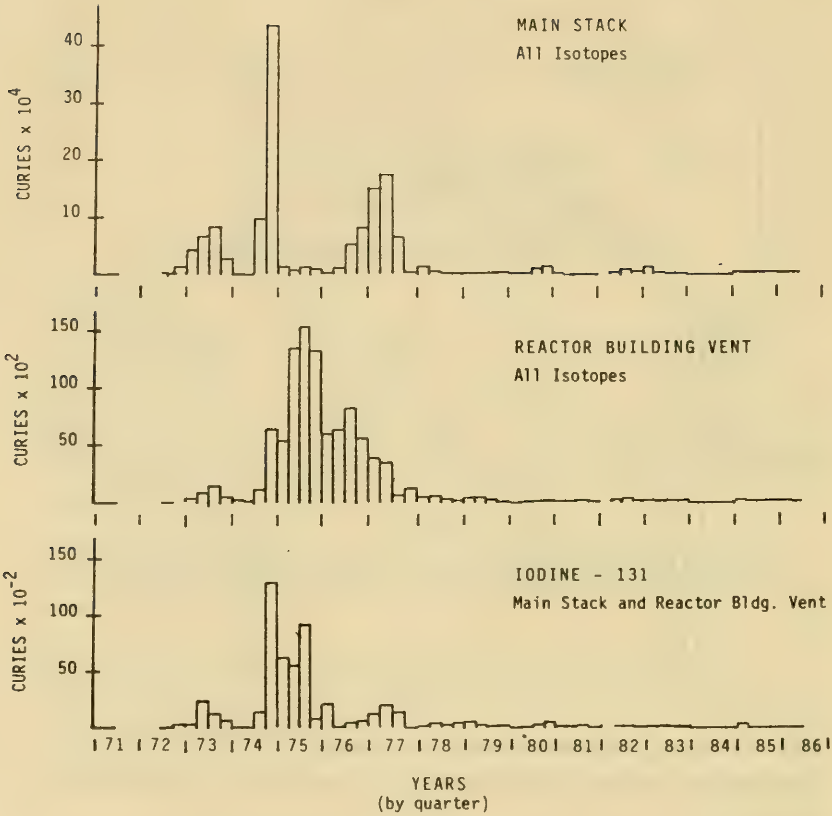


Fig. 1 Airborne radioactive effluents from Pilgrim I nuclear reactor in Plymouth, MA, by quarter, 1972-1986.

(Source: Boston Edison Semi-Annual Effluent Reports to USNRC)

Table 1.

Incidence of Hematologic Malignancies (ICD 169)

in Five Coastal Towns, 1982-1984.

	Male		Female		Total		95% test-based
Malignancy	Obs/Exp	SIR	Obs/Exp	SIR	Obs/Exp	SIR	Conf. Int.
All H & RE*	31/18.1	171	21/15.2	138	52/33.4	156	118,206
Leukemia	22/12.1	182	12/9.3	129	34/21.4	159	113,224
Leukemia minus CLL	19/9.4	203	8/7.6	106	27/16.9	160	108,237
Myelogenous Leukemia	13/5.2	252	6/4.8	126	19/9.9	191	120,304

*All Hematopoetic & Reticuloendothelial

TABLE 1. TOP RANKING HSAs FOR THE PERIOD 1975-6 IN EXCESS INFANT MORTALITY AND CONGENITAL DEFECT RATES

RANK	IMR		CDR	
	HSA	RATIO	HSA	RATIO
1	[illegible]	1.[illegible]	[illegible]	1.8
2	[illegible]	1.[illegible]	[illegible]	1.8
3	[illegible]	1.4	[illegible]	1.8
4	[illegible]	1.[illegible]	[illegible]	1.[illegible]
5	[illegible]	1.[illegible]	[illegible]	1.6
6	[illegible]	1.[illegible]	[illegible]	1.5

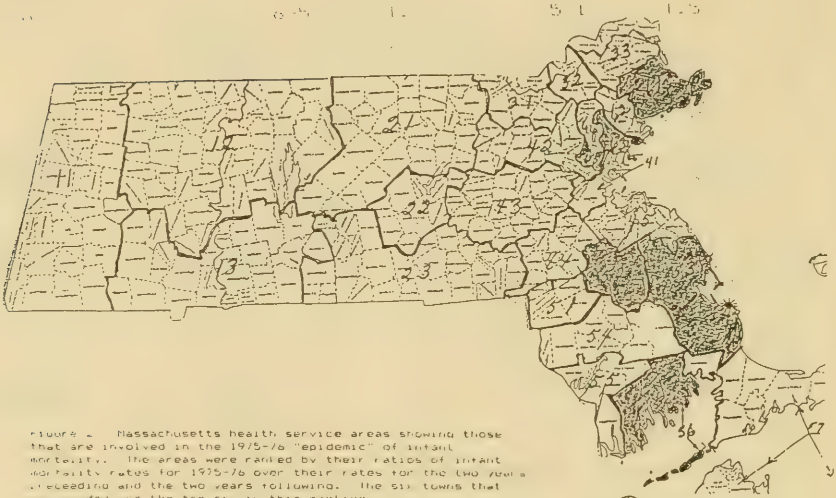


Figure 2. Massachusetts health service areas showing those that are involved in the 1975-76 "epidemic" of infant mortality. The areas were ranked by their ratios of infant mortality rates for 1975-76 over their rates for the two years preceeding and the two years following. The six towns that are shaded are the top six in this ranking.

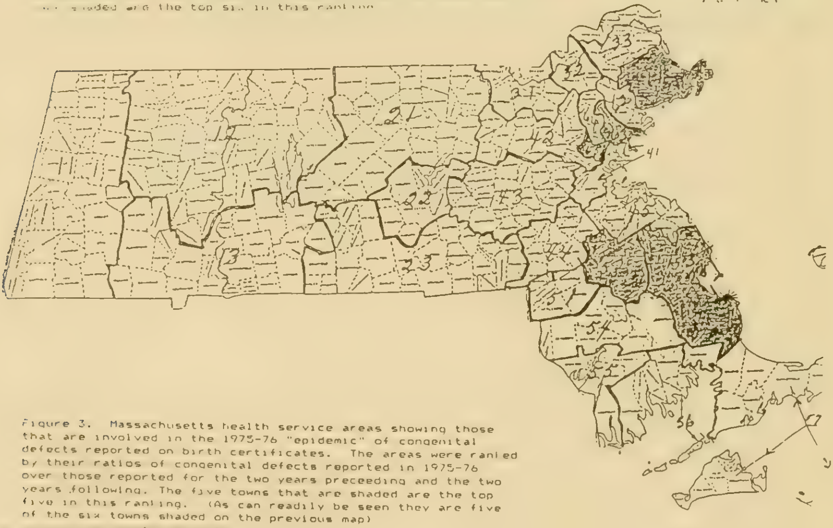


Figure 3. Massachusetts health service areas showing those that are involved in the 1975-76 "epidemic" of congenital defects reported on birth certificates. The areas were ranked by their ratios of congenital defects reported in 1975-76 over those reported for the two years preceeding and the two years following. The five towns that are shaded are the top five in this ranking. (As can readily be seen they are five of the six towns shaded on the previous map)

Letters to the Editor

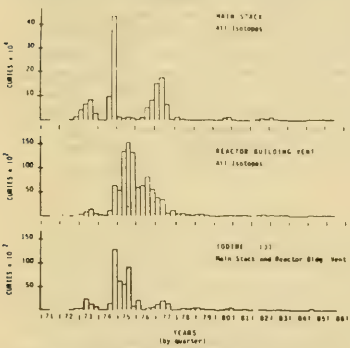
* * * * *

LEUKAEMIA NEAR MASSACHUSETTS NUCLEAR POWER PLANT

SIR,—Your Oct 17 issue (p 924) carried a note about the latest review of cancer around nuclear installations in Britain. We observed an increased incidence of leukaemia, particularly myelogenous leukaemia, in a five-town area in Massachusetts during the years 1982–84. One of those towns (Plymouth) is the site of a commercial nuclear power plant that began operations in late 1972 and from which releases of various isotopes in late 1974 and 1975 have been recorded (figure).

The standard incidence ratios (SIR) for all haematopoietic and reticuloendothelial system (ICD 169) neoplasms, all types of leukaemia combined, and all types of leukaemia minus chronic lymphocytic leukaemia are presented in table I. The standard rates from which the SIR values were calculated are the statewide rates for Massachusetts for 1982–84. These are for all ages combined, although it is of interest that the excess was in adults and the elderly, not in those under 25 as noted in British data. The most striking excess was for myelogenous leukaemia in males.

We calculated age-adjusted morbidity odds ratios, comparing the incidence in the five coastal towns with that in the surrounding communities in south-eastern Massachusetts. The rationale for this was that there might be a registration effect whereby patients from these towns might be more likely to be diagnosed and reported to the Massachusetts Cancer Registry than patients in the State as a whole. A further consideration is the fact that about 90% of the patients from the five-town area and the rest of south-eastern Massachusetts are captured in a regional registry system (Healthstat, Inc). It might be argued that the diagnostic and coding conventions used by this regional registration system differed from those used in hospitals elsewhere in Massachusetts, although we know of no evidence to support this. The odds ratios comparing the incidence in the five-town area and the two comparison areas for the four-year period 1982–85 are presented in table II. We conclude that a registration effect is not a plausible explanation for the apparent excess in the five-town area for this time period.



Airborne radioactive effluents from Pilgrim I nuclear reactor in Plymouth, Massachusetts, by quarter, 1972–86.

Source: Boston Edison semi-annual effluent reports to USNRC.

Since the nuclear power plant is on the coast and since the reported releases of radioactive effluents are too small to produce a doubling of myelogenous leukaemia in residents of the towns, we must postulate a mechanism by which airborne releases are contained in a coastal pattern. Such a meteorological mechanism is well known to weather observers,[1] and, in this instance, could contain airborne effluents and recycle them over the immediate coastal area. No other series of towns along the Massachusetts coast had had similar increases in leukaemia or in the myelogenous subtype.

TABLE I—INCIDENCE OF HAEMATOLOGICAL MALIGNANCIES (ICD 169) IN FIVE MASSACHUSETTS COASTAL TOWNS, 1982–84

Diagnosis	Male	Female	Total
All*	31 18 1 (*171*)	21 15 2 (*138*)	52/33 4 (*156, 118–206*)
Leukaemia	22 12 1 (*182*)	12 9 3 (*129*)	34/21 4 (*159, 113–224*)
Leukaemia minus CLL	19 9 4 (*203*)	8 7 6 (*106*)	27/16 9 (*160; 108–237*)
Myelogenous leukaemia	13 5 2 (*252*)	6 4 8 (*126*)	19/9 9 (*191, 120–304*)

*All haematopoietic and reticuloendothelial system neoplasms.
Results are shown as observed/expected (and SIR, with 95% confidence interval for total).
CLL = chronic lymphocytic leukaemia.

TABLE II—ADJUSTED ODDS RATIOS FOR HAEMATOPOIETIC AND RETICULOENDOTHELIAL SYSTEM NEOPLASMS IN FIVE COASTAL TOWNS COMPARED WITH SOUTH-EASTERN MASSACHUSETTS AND THE STATE, 1982–85

—	South-eastern Massachusetts	Massachusetts
Males	1 52 (35), 1 06–2 18	1 56, 1 09–2 20
Females	1 19 (28), 0 80–1 76	1 35, 0 93–1 98
Total	1 38 (63), 1 06–1 81	1 49, 1 15–1 95

Numbers in parentheses refer to no. of cases.

Clearly, more detailed modelling of the meteorological conditions in the mid-1970s is needed before dose estimates could be made. Nevertheless, these descriptive data are suggestive and will be followed by more investigations and more intensive observation of cancer incidence trends around this and other US nuclear power plants.

Massachusetts Cancer Registry — RICHARD W. CLAPP

Harvard University, Cambridge, Massachusetts — SIDNEY COBB, C. K. CHAN

SUNY, Albany, NY — BAILUS WALKER, JR

1. Field F. Dr Frank Field's weather book. New York: Putnam, 1981.

The Commonwealth of Massachusetts
Executive Office of Human Services
Department of Public Health

Division of Health Statistics & Research
150 Tremont Street, 7th floor
Boston, Massachusetts 02111

~~Bailus Walker, Jr., Ph.D., M.P.H.~~
Commissioner

December 15, 1987

Memorandum

To: Bruce Cohen

From: Dick Clapp RWC

Subject: Epidemiology Resources, Inc. Critique

As we have discussed, I wanted to do some calculations in response to the analyses done by ERI in their Sept. 11, 1987 document entitled, "Leukemia Incidence in Communities in the Vicinity of the Pilgrim I Nuclear Power Generating Station." From their text, you can see that their analyses are based on data they received from me, although many of their arguments are directed toward a March 16, 1987 report issued by the Center. It seems that the key argument made by ERI is that the "coastal meteorological conditions" that led to a focus on the five towns including Plymouth represents undocumented conjecture. They note that the only meteorologic reference cited is to Dr. Frank Field's Weather Book. In fact, there are many technical and non-technical meteorologic references to the phenomenon and it is well-known not only to researchers but to residents along the coast; the reason to use the Field reference is that it has a particularly clear figure.

Having dismissed the coastal meteorological theory as a valid basis for selecting towns for analysis, ERI go on to propose a concentric circles model based (approximately) on linear distance from the power plant and ignoring any meteorologic or plume dispersion analyses. They refer to it as a "proximity-based exposure hypothesis" (p. 34). Their concentric circles analyses are summarized in Tables 6 and 7 and they claim the results favor this "exposure scale under the causal hypothesis." (ibid.)

I think it is important to highlight how the concentric rings analysis compares to the equivalent analyses based on a coastal meteorologic pattern, so I have re-cast the data for the years 1982-84 into Zones I', II' and III' and summarized them in the attached Tables. These Zones start with the five original coastal towns as Zone I', then the next contiguous inland towns as Zone II' (Norwell, Pembroke, Halifax, Plympton, Carver, and Wareham), and finally, the next contiguous inland towns as Zone III' (Hanover, Hanson, East Bridgewater, Bridgewater, Middleboro,

and Rochester). This is approximately the same as a decreasing exposure zone analysis, as done by ERI in their Table 6, but with a meteorologic dispersion model in mind; this, too, is theoretical and would be improved by the types of data being considered by Dr. Spengler and his colleagues under contract to the Center. Nevertheless, the conclusions from this analysis are quite different from those in the ERI document. In particular, the pattern of myelogenous leukemia seems to show a monotonic decline in both males and females as one goes further inland. Based on the findings of the A-bomb survivors, this is the only type of leukemia that one would expect to observe in a time period as short as 8-10 years from exposure, which is what we are talking about in these data.

I do not think it is necessary to respond formally to the ERI report, and I do not intend this to be such a response. For one thing, I would like to know more about how they did their calculations in Table 7 before going on record in a formal way. Also, I was intrigued by their use of the Radioepidemiological Tables and would be interested in hearing from someone who is familiar with them whether they were used properly. In any case, I would be interested in your reactions and comments on the attached Tables.

cc: Dan Friedman

Table 1
SIRs in ERI Zones I-III
including Marshfield

Leukemia Type	Zone I		Zone II		Zone III	
	Males	Females	Males	Females	Males	Females
All ICD 169	118	116	121	82	142	106
Total Myelogenous	206	54	153	103	147	78

Table 1a
SIRs in ERI Zones I-III
excluding Marshfield

Leukemia Type	Zone I		Zone II		Zone III	
	Males	Females	Males	Females	Males	Females
All ICD 169	118	116	90	87	142	106
Total Myelogenous	206	54	102	42	147	78

Table 2
SIRs in Zones I'-III'

Leukemia Type	Zone I'		Zone II'		Zone III'	
	Males	Females	Males	Females	Males	Females
All ICD 169	170	136	94	65	59	92
Total Myelogenous	265	122	65	97	61	31

MAINE YANKEE ATOMIC POWER COMPANY •

EDISON DRIVE
AUGUSTA MAINE 04336
(207) 623-3521

August 4, 1987

Dr. Sidney Cobb
4 Water Street
South Easton, MA 02375

Dear Dr. Cobb:

It has come to our attention that you have made statements before the Joint Committee on Energy of the Massachusetts General Court that concern the safety and health effects of the operations of our company.

A copy of your remarks at the legislative hearing is attached for your reference.

Contrary to the unsupported allegations you made, in so public a forum, in fact there has been no evidence of adverse effects on public health from the operation of the Maine Yankee plant, as documented by the Center for Disease Control 1982 Study and the yearly Cancer Registry Reports, generated by the Maine Department of Human Services, Bureau of Health, Division of Disease Control.

The pertinent facts are as follows:

1. A critical review of the CDC data and 1983-1985 Maine Cancer Registry data reveals that leukemia incidence is not rising as you implied, but rather is actually below the National average as evidenced by negative Z scores for all five counties surrounding Maine Yankee.

2. Environmental monitoring surveillance data indicates that the radiation exposure to persons living within ten miles of the plant is on the order of a few hundreths of one percent of the exposure received from the average natural radiation level found in Maine. This is far less than the normal variation in background radiation due to varying geological formations and radon concentrations found throughout the State. To attribute any particular effect to an extremely small exposure increment which is only a small fraction of the normal variation found in the environment is utterly unjustifiable.

Dr. Sidney Cobb - 2 - August 4, 1987
4 Water Street
South Easton, MA 02375

3. Maine Yankee Atomic Power Plant has one of the finest safety records of the industry. The plant has never had an incident requiring activation of any of its emergency safeguards equipment. The plant has never even had an "Alert" level event. Normal radiological releases are routinely held to tiny fractions of the federal guidelines. The plant has never had a worker exposed in excess of federal guidelines.

We are certain, Dr. Cobb, that you recognize how damaging your unfounded and untrue accusations can be to our company and the confidence Maine people have in the plant.

Our purpose in sending this correspondence is to either: 1) have you acknowledge in writing that your statements to the Massachusetts Legislature on March 24, 1987, concerning Maine Yankee were false and inaccurate; or 2) have you supply us with credible scientific evidence in support of your allegations within ten business days of the date of this letter.

This is obviously a very serious matter and we trust you will respond to this inquiry. However, if you choose to ignore this letter, we will presume it is because you have no scientific evidence to substantiate your damaging allegations, and we will proceed accordingly.

Sincerely,

David T. Flanagan
Senior Vice President
Law and Administration

4 Water St.
N. Easton MA 02375
August 14, 1987

Mr. David T. Flanagan
Maine Yankee Atomic Power Co.
Edison Drive
Augusta, ME 04336

Dear Mr. Flanagan:

This is in reply to your letter of August 4, in which you request "credible scientific evidence" to support my testimony about Maine before the Joint Committee on Energy of the Massachusetts Legislature. It was with the data presented in the 1987 report by Stutzman et al. of C. D. C. that I started my investigation. I have always been one to pay more attention to the data presented in a scientific paper than to the opinions offered by the authors. This is one of the cases in which this behavior pattern served me well. What I found in table 1 was that the rates for leukemia in Maine have been consistently lower than those found in the Third National Cancer Survey and that the rates for the counties down wind of the nuclear plant in Wiscasset, Lincoln, Knox and Waldo, were if anything even lower through the year 1976 or 1977. This made me think that it was probably most appropriate to compare the recent leukemia experience of the three counties with their own previous experience. Since numbers were small and the populations of those counties were not changing very rapidly, it seemed sensible to look at the very simplest set of numbers, namely the number of leukemia cases identified each year.

I plotted the number of leukemia cases per year that were identified by Stutzman et al. for each year from from 1969 1980. Similar data obtained from the publications of the Maine Cancer Registry were plotted for 1983 & 1984. No data are available for the years 1981 & 1982. This graph was presented as the first figure in the handout used in my presentation to the American Epidemiological Association on March 18, 1987. (Unfortunately the graph was labeled fig. 4, which has created a certain amount of confusion.)

I enclose a copy of this handout for your convenient reference. In examining this you will note that my co-authors include Richard Clapp, Director of the Massachusetts Cancer Registry, and Bailus Walker Jr., who is President-elect of the American Public Health Association and former Commissioner of Health for the Commonwealth of Massachusetts. Both of these

men checked the data and the interpretations before agreeing to the presentation.

I also include an extra copy of the graph, to which I have added by hand the now available data for 1985, and onto which I have sketched an approximation of the smoothed curve that might represent the outbreak. This figure shows that the average number of cases of leukemia in these counties during the period 1969-75 was just under four per year. In the period 1976-9 the number of cases increased approximately four fold to 15 per year, at which level it remained for a second year before beginning a gradual decline to 8 cases in 1985. It is regrettable that we don't have data for the years 1981-3, for they might give us a better understanding of the exact shape of the curve.

It should be noted that the 1985 data were not available to me in time to be included in the presentation in March. However these 1985 data strengthen the conclusion that the outbreak had at that time not yet run its full course.

Credible scientific evidence has been presented that supports the conclusion that an outbreak of leukemia in the counties of Lincoln, Knox and Waldo began in about 1977 and was continuing at least through 1985. No claim is made that this is all the evidence that there might be. Please note that my original testimony was that this matter had as yet not been thoroughly investigated. I believe that a full, fair and open investigation should be undertaken.

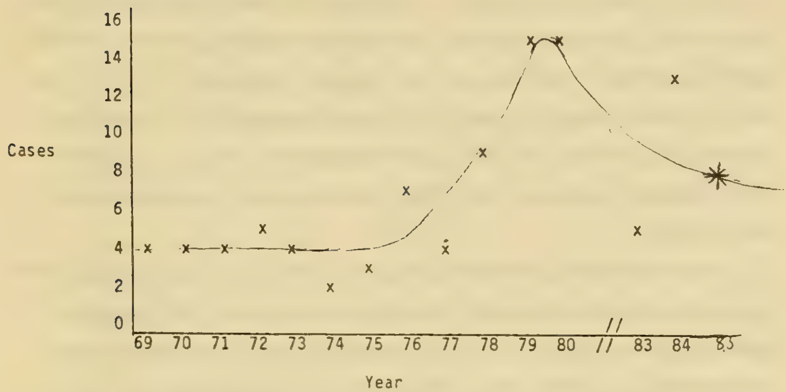
Sincerely,

Sidney Cobb MD
Professor Emeritus of Community Health
Brown University Medical Program

Figure 4.

Leukemia Incidence in Lincoln, Knox and

Waldo Counties, Maine, 1969-80 and 1983-84



NOTE: The data from 1969-1980 are from Stutzman, et al (13). The data for 1983-1984 are from the State of Maine (14). There were no published data in 1981-1982. ✳ represents data for 1985 not included in the original presentation to the American Epidemiological Association.

THE POTENTIAL ADVERSE HEALTH EFFECTS OF THE PLYMOUTH NUCLEAR POWER FACILITY

Belton Burrows, M.D. and Donald Muirhead, Jr., M.D.

No one doubts or denies the inherent dangers associated with high level radiation exposure. The biological consequences over time of low level radiation exposure have not been well documented although studied extensively. However, increasing evidence should warn us that low level radiation may cause significantly greater health problems than have previously been realized. Pilgrim I has now been shut down for nearly two years because of a number and variety of problems related to mismanagement, faulty equipment, safety design problems, poor SALP reports, and no workable evacuation plan.

Both the authors are medical physicians. Dr. Burrows has been an internist specializing in Nuclear Medicine at the University Hospital for 38 years. He has recently attended workshops and conferences on non-military radiation emergencies and the consequences of the Chernobyl accident. Dr. Muirhead is a pediatrician with a subspecialty in Neonatology, and in practice for 24 years on the staff of Massachusetts General Hospital, Children's Hospital, and the Brigham & Women's Hospital.

Senator Kennedy, we appreciate being asked to present written testimony this evening, and shall confine our remarks to the potential adverse health effects of the Pilgrim I nuclear power plant upon the surrounding population. Three facts should set the stage.

Page Two

1) In 1986, the Massachusetts Department of Public Health extensively studied the population surrounding Pilgrim I and observed a two to nearly three-fold increase in certain types of leukemia and multiple myeloma above expected levels.

2) Pilgrim I is nearly 15 years old and historically has a track record of known planned and unplanned releases of radio-nuclides into the surrounding salt water and atmosphere.

3) There is an increasing body of scientific and recorded anecdotal information regarding the potential health consequences of low level radiation emitted from nuclear power plants. In addition to earlier and recent experimental evidence which will be noted, the problems of Hanford, TMI, Chernobyl, Maine Yankee, and other nuclear plants in England and Wales will also be discussed. Significant papers by Stewart; Cobb and Walker; Hauschka and Holt; Relman, Lambie, Burrows, and Roy; Forman and Sternglass have been written presenting evidence strongly linking the radio-nuclides from nuclear power plants to the biological effects resulting in congenital anomalies, cancer, and low birth weights. This data is not reassurring and is growing.

The Nuclear Regulatory Commission has agreed and commented that no level of radiation is completely safe. In 1978, the occupation exposure limit was set at 5 rems/year, down from 52 rems/year set back in 1920. The National Council on Radiation Protection set the public exposure at 0.5 rems/year and 170 mrems average/persons/year. Thus, the "workers" were being allowed over ten times the amount of exposure thought safe to the public at large because the major concern was for the genetic burden of

radiation to the total population! This amounts to over 2 million radiation workers. The NCRP and ICRP acknowledged that the 5 rems "involved a compromise between deleterious effects and social benefits", and "provides reasonable latitude for the expansion of atomic energy programs in the foreseeable future"--1965.

Radiation comes from two basic sources: First is the NATURAL radiation, which is made up of cosmic rays, radiation from the earth (such as granite and soil), and the hydrogen, carbon, and potassium in our bodies. This amounts to approximately 100 mrems/year/person, varying particularly according to altitude. The second source is MANMADE radiation. This is largely made up of a) medical x-rays and injected or implanted radionuclides, b) nuclear weapons testing, and c) nuclear power facilities. It is very important to note that manmade fission products such as Cesiuim 137, Iodine 131, and Strontium 90 may be up to 1,000 times biologically more dangerous internally than an equivalent amount of external radiation. One should not combine the manmade sources with naturally occurring radiation. The nuclear industry and the NRC frequently refer to the nuclear facilities as adding "less than 1% more to background radiation", in which man-made environmental radioactivity is apparently included. As has been pointed out, they are vastly different entities with equally different consequences.

The health effects from radioactive releases break down into 1) Immediate effects: as shown by TMI and Chernobyl, we are unlikely to have many immediate deaths from acute radiation

radiation sickness or explosions, 2) Delayed problems of a mutagenic or cancerogenic nature. Most likely these would result from relatively low level radiation and come from either continuous planned emission, unplanned, small emission, or a major accident. The individual health effects of any of these scenarios depends on a number of variables. These include: a) weather--wind, precipitation; b) age of the patient--very young and very old are most susceptible; c) present illness--immune problems, genetic problems; d) shelter--wooden/glass give only about 10% protection whereas stone or brick add 20-40% protection from radiation.

What have we learned from previous accidents at nuclear power plants? The accident at Three Mile Island continue to engender conflicting information regarding cancers, etc. There have been approximately 2,500 suits to date with 300 settled out of court for $14.5M. Dr. E.J. Sternglass, Professor of Radiation Physics at the University of Pennsylvania said, "the rise (following the accident) moved Pennsylvania from well below the U.S. average to the highest infant mortality rate east of the Mississippi River".

The Hanford Study of workers showed 10-30 times expected cancer rates with low level radiation.

The Department of Energy Study also reported excessive cancer rates among workers.

The Chernobyl accident has been well documented and the Department of Energy estimated that 21,000 Europeans would die of cancer over the next 50 years. It was estimated that 3 million curies fell over Europe and the Northern Hemisphere, the total amount

being a significant fraction of the fallout from all atmospheric weapons tests. Cesium 137 (half life of 30 years) accounts for approximately 20% of all long-lived fission products.

In NATURE, October, 1987, Forum et al examined the study "Cancer Incidence and Mortality in Vicinity of Nuclear Installations in England and Wales from 1959-1980". The populations around 15 nuclear plants were compared with an equal number of control populations. They concluded that there was a possible increase in leukemia, multiple myeloma, and Hodgkin's disease around the nuclear facilities.

In 1986, Sidney Cobb, M.D. and Bailus Walker, M.D. of Massachusetts reported that in the Pilgrim I area there was an increase in low birth weights, congenital anomalies, and cancer, particularly over the downwind communities.

Dr. Alice Stewart from England showed in the Oxford Thirty Year Study, a 2-3 times the usual leukemia rate in infants of mothers who had received early prenatal x-rays.

Hauschka and Holt showed at the Maine Yankee nuclear power plant that there was an increase in leukemia in surrounding downwind areas after the plant began operations in 1972.

In the 1950's, Relman, Lambie, Burrows, and Roy showed that Cesium 137 is preferentially taken up by the muscle cells instead of potassium. This resides in direct proximity to DNA. There have been no adequate measurements of internal body burden of radioactivity and outcome. Said Dr. Burrows, "Until more reliable information is obtained to rule out any deleterious effects, it would seem prudent to avoid further global accumulation of fallout

radionuclides that might become available to biological systems". (Burrows, Cardarelli, Sinex, Lefkin, and Teager, 1982).

An unending stream of problems at the Pilgrim I power plant, coupled with seemingly unsurmountable logistical and geographical problems vis a vis the evacuation plan presently suggests to the NRC that Pilgrim I is not ready for restart! Even with better management and better evacuation plans, we feel that these serious potential health problems will remain for a much larger population than most believe. The information collected is too horrifying not to heed, of too great a magnitude not to thoroughly study, and has potential consequences of too lasting a nature.

In 1986, George Woodwell of Brookhaven National Laboratory and Director of the Woods Hole Research Center said, "Reactors are intrinsically complicated and unstable. There operation as with so much of human enterprise, is a compromise with safety. From time to time there will be reactor accidents that will progressively and irreversibly contaminate the biosphere...It seems clear that we have given nuclear power a fair trial and that its promise falls far short of even the most modest hopes. The earth is not large enough to accommodate this technology..."

To summarize, there is a growing and impressive list of papers documenting mutagenic and carcinogenic effects of low level radionuclides, particularly Cesium 137, Iodine 131, and Strontium 90. The community surrounding the Pilgrim I power facility has been shown to have a two to nearly three-fold increase in the number of cases of leukemia. Lastly, similar reports concerning a rise

Page Seven

in rates of leukemia in other communities with nuclear power plants have been published. This information, added to the poor track record of Pilgrim I, only reinforces our resolve to recommend that Pilgrim I be kept closed until the issues of safety and potential health effects can be satisfied.

Belton Burrows, M.D.
50 Edgehill Road
Brookline, MA 02146

Donald M. Muirhead, Jr., M.D.
23 Lovers Lane
Duxbury, MA 02332

Eileen Kugelmann
P.O. Box 71
South Chatham, MA 02659
(617) 430-0875

TESTIMONY FOR:
SENATOR EDWARD M. KENNEDY'S
LABOR AND HUMAN RESOURCES COMMITTEE HEARING
REGARDING THE HEALTH AND SAFETY ISSUES
OF THE PILGRIM I NUCLEAR REACTOR IN PLYMOUTH, MASS.

January 7, 1988

SUBMITTED BY: Eileen Kugelmann, Director
Mass Safe Energy Alliance (SEA): Cape Cod

Mass SEA: Cape Cod is a citizen group whose primary mandate is to keep the Pilgrim nuclear power station closed. Mass SEA's members are concerned about all issues related to the Pilgrim reactor. Our concerns regarding Pilgrim's health and safety issues are as follows:

1. We are angry and concerned about the lack of an evacuation plan for Cape Cod and the islands. With the Pilgrim reactor in our back yard, we are trapped here in the event of an accident (or "incident") at Pilgrim. Further, we are convinced that no evacuation plan, whether or not it takes the Cape into account, is feasible.

Since there is no evacuation plan for our area, none of Barnstable County's public service organizations, such as our hospitals, are prepared to cope with an accident at Pilgrim. Our hospitals are not equipped properly to handle, at one time, more than one or two victims of radiation exposure.

2. The Pilgrim reactor has been mismanaged from the start, and this mismanagement translates into serious threats to our health, above and beyond the health hazards inherent in nuclear technology.

3. We are enraged at and disappointed in Boston Edison Company and the Nuclear Regulatory Commission for consistently and consciously witholding information about mishaps at Pilgrim, and for deliberately misleading the public about the critical problems with Pilgrim's evacuation plan, its safety standards, and its management.

Thank you for this opportunity to air my concerns, and the concerns of my group, regarding this nuclear monstrosity called Pilgrim I.

Sincerely,

Eileen Kugelmann

January 8, 1988

Senator Edward M. Kennedy
Room 2400A JFK Bldg.
Boston, MA 02203

Dear Senator Kennedy:

Would like to thank you for holding the hearing last Thursday in Plymouth. I am writing as a member of the Nuclear Affairs committee for the town of Scituate and also as a concerned citizen as Boston Edison talks about asking for permission to restart.

In December the League of Women Voters in Scituate hada debate between members of CURE, MASSPIRG and Boston Edison on affairs concerning the Pilgrim I plant in Plymouth. In Duxbury's latest Emergency Response Plan from Boston Edison in May 1987, Page 40 Table 2-2, Scituate is listed as a "Secondary Shelter Community", capable of sheltering 4,800 persons in our schools. Our Civil Defense Director, Walter Stewart who is also our Fire Chief has never been contacted or consulted on our participation. I have been told Mr. Bergman, our Administrator is intending to write a letter to Boston Edison expressing our displeasure at being included without our permission. As another source of information, I went to the Plymouth Public Library recently and consulted their latest Emergency Response Plan which is from 1985. We are also listed there on Page 25 along with 17 other schools, which probably have not been contacted either. Incidently, Hanover Mall is still listed as their "Primary Reception Center"; although they pulled out of the plan at least a year ago. This is their latest plan for the people to rely on for directions in case of an emergency. If Scituate is supposed to be prepared to shelter 4,800 people I think they should at least know about it! At the League of Women Voter's meeting in Scituate when questioned about our part in the evacuation we were told by Boston Edison's new Director of ERP, who consulted with another "expert" there that we were not in the plan. The members of CURE and concerned are more informed than Boston Edison's management. When I called his office the other day for a description of "Secondary Shelter Community", I was told they no longer use Duxbury's 1987 plan and that Plymouth's 1985 plan is accurate; the one that lists Hanover Mall as Primary Reception Center. Needless to say, I was more confused after I hung up!

I would like this information entered as part of the testimony for keeping Plymouth plant closed permanently. Another example of Boston Edison's mismanagement & blatant disregard for the safety of the South Shore citizens.

Respectfully,

Judy Theriault
106 Mann Hill Road
Scituate, MA 02066
545-2300

STATEMENT OF

STATE SENATOR EDWARD P. KIRBY

FOR THE UNITED STATES SENATE COMMITTEE ON

LABOR AND HUMAN RESOURCES

EDWARD M. KENNEDY
CHAIRMAN

January 6, 1987

COMMONWEALTH OF MASSACHUSETTS
MASSACHUSETTS SENATE
STATE HOUSE, BOSTON 02133

SENATOR EDWARD P. KIRBY
SECOND PLYMOUTH DISTRICT
ROOM 413-H
TEL (617) 722-1330

COMMITTEES
WAYS AND MEANS
TRANSPORTATION
CRIMINAL JUSTICE
ENERGY

January 6, 1988

I commend Senator Kennedy for coming to Plymouth to hold this hearing. It is regrettable that the time allowed for it is so short. Were there more time made available, perhaps the Senator from the district including the Town of Plymouth, would have been invited, and an effort made to secure for the committee the use of the work-product of the special joint legislative Committee created by an order I filed in 1986, which conducted lengthy hearings in 1987. I am thankful to Senator Kennedy and the Senate committee on Labor and Human Resources for allowing me the opportunity to present a statement.

Recognizing that this hearing was called at the request of Senator William B. Golden, I expect that the greater part of the committee's time in Plymouth will be devoted to hearing the views and data to be adduced by those who oppose

the restart of this generating facility under any circumstances. The Senator's mind is already made upon the issue.

Senator Golden has already circulated a petition asking the stockholders and board of directors of Boston Edison to shut the Pilgrim Nuclear Power plant down and press reports indicate his reason is that it is not cost effective. Senator Golden has said he believes the Pilgrim Plant should be converted to a natural gas fired plant. Whether such a move would really save money is questionable, but there is no question that one of the environmental effects of burning anything is to produce vast amounts of Carbon Dioxide, aggravating the greenhouse effect, and increasing sea levels and moisture in the atmosphere.

Granted, there are environmental risks attendant to nuclear operations, but risks attend all combustion systems for generating power, so Senator Golden's gas-fired proposal is hardly a certain alternative for restarting Pilgrim.

Also, such a move would have more immediate environmental effects on the community.

If the plant were to be shut down, perhaps the town of Plymouth and its citizens should have something to say about the next use of the property.

The issue of the effect of Pilgrim's operation on area residents' health and safety is one that merits further study. The Massachusetts Department of Public Health is already planning such studies but awaits state budgetary support. There have been highly publicized reports that are said to prove a higher than average incidence of cancer among those living near Pilgrim. Presumably testimony about those will be presented to your committee. These reports are far from conclusive.

One who does not believe that Pilgrim is responsible for increased incidences of cancer is Dr. Joseph Ring, a senior health physicist at Harvard University. In a letter dated November 30, 1987 he states that such a conclusion is based on mistaken interpretation of the data. To quote Dr. Ring, "...The data I have accumulated show that there has not been any significant increase in the background radiation levels as monitored by TLD's [radiation detection devices] in

the area outside of the Pilgrim Nuclear Power plant." In fact, Dr. Ring suggests in this study that if, indeed, impermissible radiation had been emitted from Pilgrim, no increase in the incidence of cancer would be noticeable for 30 years after exposure (based upon atomic bomb survival data). The Pilgrim plant has only been operating for 15 years. Research shows, according to Dr. Ring, that the incidence of cancer from natural causes in a given population is vastly higher than what could be expected as the result of exposure from a nuclear power plant. Therefore, detecting the effects of radiation from Pilgrim, or any other nuclear power plant, on populations near the plant is difficult, if not impossible.

An editorial in the Sunday, December 27 Boston Globe pointed out that New England protest has focused on "hypothetical danger from a still-inoperative nuclear power plant ... where no death has taken place and none is apt to", and cited in contrast, the subdued level of concern for those who perished in the Phillipine tanker-steamer accident which recently claimed at least 1,570 lives.

I believe that it is unconscionable to exploit this issue in such a way as to increase the fears of the residents. The residents of Plymouth and surrounding towns have been subjected to a drum-fire of sensational statements and one-sided interpretations concerning Pilgrim. I strongly sympathize with them over their anxiety. It is time that a more objective view is taken of the entire situation and that people hear some assurances about their safety, their health, and the truth about the true measure of risk we all face concerning the plant and its future management.

I hope Senator Kennedy's hearing will provide the opportunity for such testimony to be given.

STATEMENT of Theodore Bosen, Anti-Nuclear Board Member, Plymouth Town Committee on Nuclear Matters

WHAT THE NRC AND BECo WILL TELL YOU ABOUT PILGRIM S SAFETY
--AND WHAT THEY WILL WITHHOLD:

Regarding Evacuation

They will tell you that any major accident at Pilgrim would not reach a point requiring a release of radioactive material into the air for several hours after onset, leaving ample time to evacuate within the 3 to 6 hours estimated by KLD Associates, Edison's consultant on time estimates.

They will withhold the following, however:

1) The NRC's most recent Reactor Risk Assessment(NUREG-1150) estimated the probability of early containment failure during a severe core melt at Peach Bottom, another Mark-I reactor, to be over 90% for most core melt scenarios.

2) A more recent study done for the NRC and published in August, 1987(NUREG-1029) concludes that Mark-I reactors have a high propensity for early containment failure during a severe core melt, resulting in a release into the environment within the first one to three hours after onset.

Regarding Safety Enhancements

They will tell you that the proposed safety enhancements now underway are designed to mitigate early containment failure in response to the five problem areas recently highlighted by the NRC staff as potential early containment failure avenues in Mark-I's.

They will withhold the following, however:

1) NUREG-1090 and NUREG-1150 indicate that most scenarios under which early containment failure is likely involve direct attack of the molten core material onto the floor of the reactor room after a breach in the containment liner. However, the erection of reactor room barriers, one of the five points suggested by the NRC as a potential factor in mitigating early releases, has been rejected as a safety enhancement option by Boston Edison.

2) Direct Torus Venting, another proposed safety enhancement designed to allow small early releases to relieve vessel pressure in order to prevent total containment failure, has been disallowed by the NRC because of uncertainty over the risks it would introduce.

3) NUREG-1150 indicates that among the highest probable scenarios for early containment failure is Station Blackout. BECo claims to be installing another

backup deisel generator to address this problem. However, industry statistics indicate that such generators are historically unavailable an average of 15% of the time, hence even with another back-up, the probability of such power being unavailable during a blackout is still significant.

Regarding Design Flaws Noted in the Reed Report

This report, issued by GE in the early 70's, noted a number of potential design deficiencies in Mark-I's. The NRC has had access to it, but only released it very recently. BECo immediately asserted that all the problems highlighted in the report have long since been remedied.

What they failed to disclose, and what the NRC will not discuss, however, is the fact that a recent reanalysis of the Reed Report by the NRC concludes that there are still 8 unresolved issues from that original report, one of which is the unreliability of the Main Steam Isolation Valve.

This valve was recently replaced by BECo because it was the root cause of the second scram of April 1986 which led to the immediate investigation by the NRC and the subsequent shutdown of Pilgrim to this date.

The NRC and BECo will not admit that these unresolved items pose any safety risks, even though the one noted above clearly did pose a serious risk which almost led to a catastrophe just a few short months ago.

Regarding Severe Accident Risk

BECo and the NRC will tell you that the risk of a severe accident at Pilgrim is extremely low.

They will not disclose the following, however:

1) A 1982 risk assessment of a similarly designed plant, Brown's Ferry, done by the industry itself, estimated a probability of severe core melt at a mean value of 2.8×10^{-4} per reactor year. That translates to about 1 in 200 over the life of a Mark-I plant. Given the previously noted high probability of early containment failure in Mark-I's, this indicates a nearly 1/200 chance that Pilgrim will render Plymouth and its surroundings uninhabitable for eternity.

Regarding Radioactive Releases

The NRC and BECo will tell you that they have not released any isotopes in excess of background levels or in violation of technical specifications.

They will not tell you that:

1) The acceptable limits were set long ago, based on data from an analysis of Hiroshima victims which has since been discredited by more recent studies which indicate that those limits may be too high by a factor of between 10 and 200. Other countries, in response to recent scientific data that suggest that low level radiation is more mutagenic than previously thought, have decreased the allowable limits by at least a factor of 10. The Federal Republic of Germany is one of these countries.

2) It is documented in BECo's own records that releases in excess of tech specs occurred over several months in the mid-70's. A DPH report correlates these releases with a high incidence of cancer and infant mortality in the area along the coast, just north of Pilgrim.

3) Plant-created isotopes are on record for samples of sediment, shellfish, algae, ocean fish, and garden produce in areas ranging from Marshfield to Bourne. This is well-documented in a report by the Plymouth Town Committee on Nuclear Matters.

Regarding Health Effects

The NRC and BECo will tell you that there is more danger in potassium table salt and X-rays than in plant releases because plant releases are at much lower radioactive levels.

They will not tell youthat:

1) An incorporated dose that lodges in body tissue as a result of its assimilation into the food chain is much more dangerous than an X-ray or other such external dose which has a limited exposure risk. Even potassium salts which are naturally radioactive do not have the propensity for replacing Vitamin B-12 in mussels or being absorbed by cranberries, as do Co-60 and Cs-137, respectively.

2) Comparing levels of released isotopes to background radiation gives the mistaken impression that there is some qualitative difference between them, when it is a fact that the effect on health is cumulative, regardless of the source. Even if , taken alone, Pilgrim is not releasing mutagenic

levels of radioactivity, the proper health question should be whether they are,or have been, increasing existing levels in the environment beyond threshhold limits for mutagenic diseases.

3) The health effects projected by the CRAC-2 computer model relied upon by the NRC in computing the health impact of a reactor accident at Pilgrim are severely understated since they are based upon old census data of the area's population and the absurd assumption that the area can be evacuated in 1 hour. As noted previously, the earliest estimate for evacuating predicted by KLD Associates is 3 hours.

Management

BECo will tell you that they have changed personnel at the top to provide better management and to prevent the mismanagement of the past.

They will not mention, however, the following:

1) This is what they said the last time they changed top level management in response to charges of mismanagement.

2) Ralph Bird, the new head of nuclear operations, was asked in a recent legislative hearing whether he had any objective indices by which to measure the adequacy of future operational performance at Pilgrim. His answer was "No, but I know a good operation when I see one".

3) Richard Starostecki of the NRC staff was asked in a 1986 public hearing whether BECo management would be good enough to manage Pilgrim safely once it went back on line. He answered that the NRC could not make such a determination without first observing a pattern of steady management improvement for at least three consecutive years.

4) When asked in a legislative hearing whether he would shut down Pilgrim completely if he saw that it could not be operated safely, Mr. Bird stated that he had been hired to manage it safely and that any other alternative would not be considered.

Conclusion

All of the statements contained herein are documented, verifiable, and credible to the best of my personal knowledge. They comprise the half of the story that the NRC and Boston Edison Company have failed to recognize for the implications it may have on the continued life of Pilgrim.

We in this community have a vested interest in our health and safety, not in the need to recover a return on an investment. Congress must heed our message and take responsibility for the risk it has allowed to be set upon us. By law, Congress has the power over Pilgrim and we have no recourse but to appeal to you. You have allowed five "revolving door" political appointees of a disinterested and detached President to run slipshod over our rights to health and safety. Must it continue until a major accident creates the proper political climate for you to act?

If the NRC refuses to discuss with you the issues I have included in this statement, many of which are contained in their own publications, and if they continue to assert that despite Pilgrim's historic mismanagement and design deficiencies, it is safe, then you must ask yourselves the question after reviewing all the information before you:

> Is a 1 in 200 chance of losing America's Hometown forever an acceptable level of risk?

If your answer is yes, then you must also ask yourself:

> Would you trust a company with a proven record of failure with such a plant, knowing that the new chief executive admits to having no objective indices by which to evaluate performance, and no intention to consider a shutdown under any circumstances?

If still you answer yes, then at least consider this:

> Would you allow your family to live in a community with an above average mortality rate from mutagenic diseases, knowing that a mismanaged nuclear plant was adding to the radiation in their environment on a daily basis?

If your answer is still yes, then you are non-representative of the citizens who live in the shadow of Pilgrim, because in November 1986, we voted 3 to 2 in a non-binding referendum to shut it down. The message was clear and I relay it to you from all the voters ofPlymouth and Kingston: STOP PILGRIM !

The CHAIRMAN. If the audience will stay for one more minute, I would like to make a final comment and then we'll break.

First of all, I would like to express our thanks to the many people here during the course of these hearings. We also want to thank WPLM for all of their good help and assistance and responses which they have given to us; Jack Campbell who has taken a great interest in this whole undertaking and all those who have been part of WPLM.

I have just a brief concluding comment. Tonight we have had the opportunity to hear from the citizens who have the most to risk in assuring that Pilgrim is safe. At least tonight they had the opportunity to have their voices heard. And we have heard from our State and local officials, expressing their frustrations in attempting to protect the well-being of their communities before a noncaring and insensitive bureaucracy. We heard from the Federal officials who are charged with the responsibility of deciding if restarting the plant can be permitted without compromising the safety of the residents.

Let me say that I am somewhat appalled by what I have heard this evening—appalled that a federal agency would ignore the advice of its own experts, especially when a similar reactor was involved in the nuclear nightmare at Chernobyl; appalled that this Federal agency would even contemplate restarting a plant without the existence of a workable evacuation plan in the event of a nuclear accident. Allowing Pilgrim to restart at this time would be disgraceful and in reckless disregard for the safety of the people who live here. It is apparent from the testimony tonight that this plant is light years away from restarting. And I want to make this commitment to you—when I return to Washington, I intend to visit with my colleagues in Congress and bring this matter to their attention. Congress should take a hard look at what it is spending your money on. The NRC has been delegated the responsibility to see that the nuclear industry adequately protects the people from the dangers of nuclear power. Instead, I'm afraid, we have seen that the NRC that is merely a spokesman for the industry.

I firmly believe that the people should have the opportunity to present the same evidence that we have heard tonight to the members of the Nuclear Regulatory Commission directly—before an adjudicatory hearing, but if they can't, I will.

Our hearing stands in recess.

[Whereupon, at 11:30 p.m., the hearing was adjourned.]

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[Whereupon, at 11:00 p.m., the hearing was adjourned.]

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